FOOD MANUFACTURE

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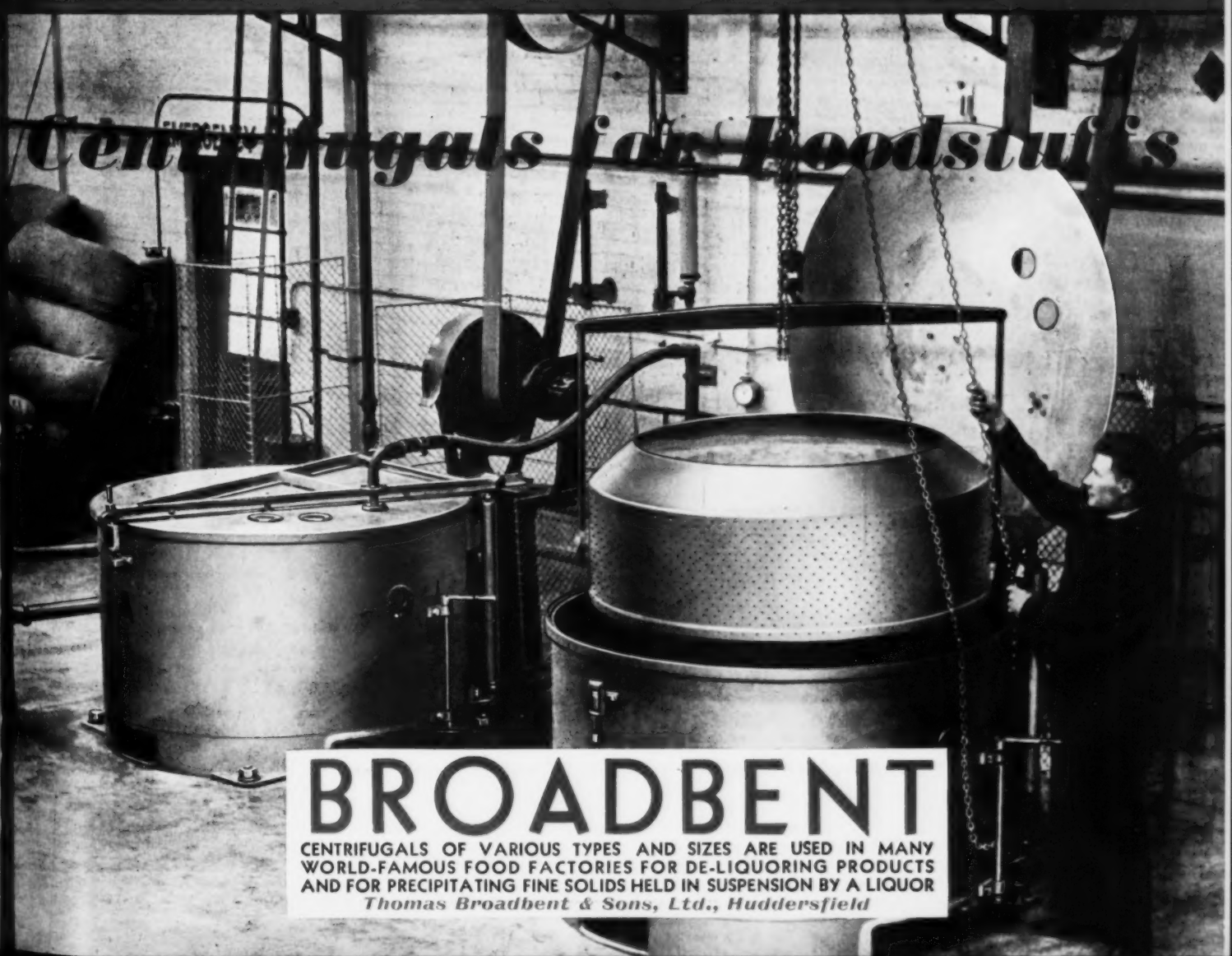
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FOOD MANUFACTURE

Incorporating Canning, Packing and Preserving.

VOLUME . . . XIV

NUMBER . . . 11

NOVEMBER 3, 1939

Dairy Products Number

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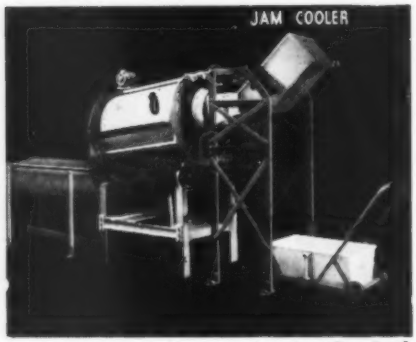
The Editor will be glad to consider contributions from those engaged in the Food Industry. Articles intended for publication should be of a practical nature and accompanied by photographs or drawings when possible.



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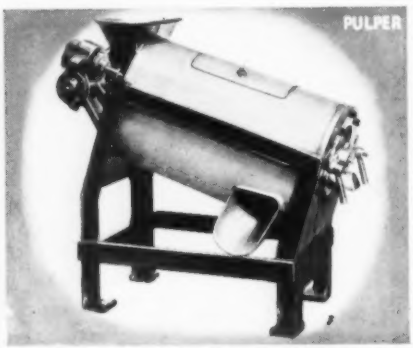

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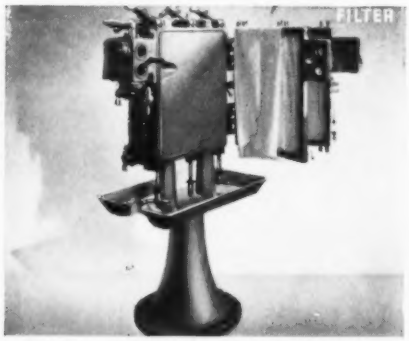

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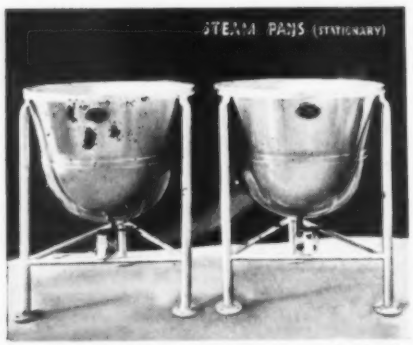

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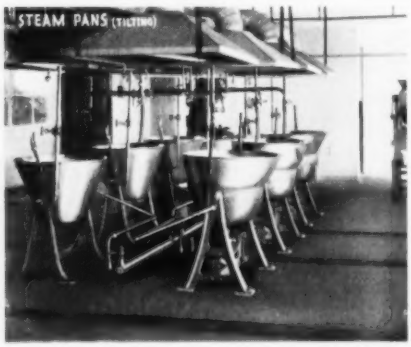

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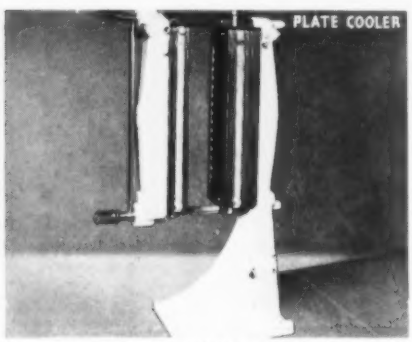

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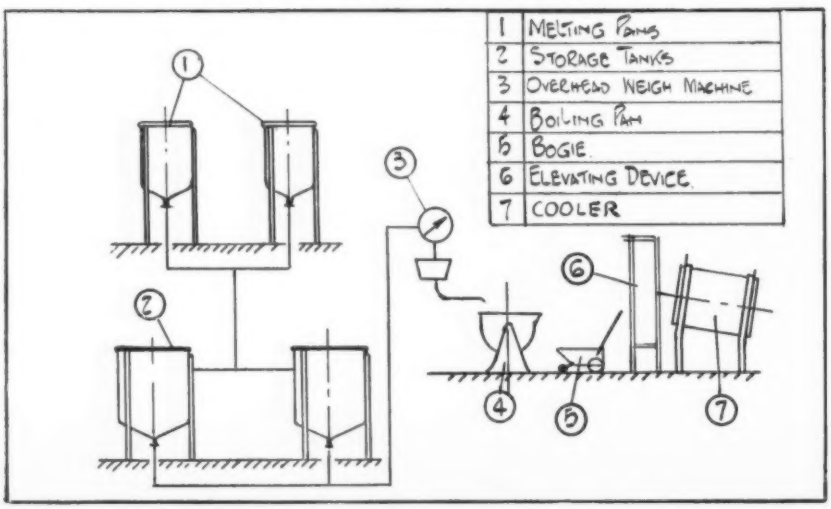

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Facing first page of Editorial

FOOD MANUFACTURE

Vol. XIV, No. 11 November 3, 1939

Our Dairy Products Issue

THE PERUSAL of the articles appearing in this issue will demonstrate that scientific research is still going on, which is as it should be. As time goes on the scientist will be called upon to fulfil fresh tasks to meet new conditions.

An issue mainly devoted to milk products would not be complete without passing reference at any rate to the matter of pasteurisation. From the medical standpoint there can be no doubt as to the opinion of the medical profession, and evidence is accumulating, not only to show the dangers of raw milk, but also that pasteurisation does not materially affect its nutritive properties.

The elaborate precautions often taken to produce milk free from tubercle bacilli have not given the safety that was optimistically expected. Examination of such milk shows that although free from T.B. it is often infected with the organisms responsible for undulant fever and with strains of hæmolytic streptococcus, both of which are liable to cause serious illness and fatalities. In one examination the proportion of samples infected with these two types of organisms was found to be respectively 73 and 63 per cent.

Gas-Milking

We have for some time suspected that the cow was one of the earliest users of gas storage of a perishable product. Most of the carbon dioxide which accompanies the milk in the udder is released by ordinary methods of milking, and its bactericidal value is reduced to practically nothing. Information about the acidity relationships of milk is regrettably scanty, and we can only surmise that the process of keeping milk sweet for long periods by acidifying it to about *p*H 5·3 at about blood heat (introduced by J. G. Davis and mentioned in the August issue of FOOD MANUFACTURE) represents an imitation of the natural method.

A group of Danish workers have apparently been thinking along similar lines, and, as a result, the Jens Grand Milking Pail has been patented in Denmark. The essential feature of the patent consists in charging the 5-gallon can with about a couple of ounces of dry ice—solid carbon dioxide—some hours before milking. The intention is *not* to cool the can, but to fill it with an atmosphere of carbon dioxide which persists during milking. The pail is called the G-can for short.

A trial of the G-can and a comparison of the quality of milk produced by it with that given by ordinary methods has been made by M. J. Griffiths and Miss B. Shield, and was reported in the *Queensland Agricultural Journal*, Vol. 52, 1939, pp. 52-59. The G-can did in most cases produce a milk with lower bacterial count after six hours at 70° F. than that obtained by milking into ordinary air, but the difference was not very marked. On keeping up to twenty-four hours, the G-can milk had a notably higher titratable acidity than ordinary milk did, but it seems probable that a large part of the acidity of the G-can milk was due to carbon dioxide and not to souring. It would be interesting to investigate this point further; curiously enough, the authors do not record the *p*H at any time.

The flavour of the G-can milk was described as sweetish and stale, and this flavour, which persisted even after aeration, was considered to make the milk unpalatable. Here again it may be the very absence of souring which led to the manifestation of this unaccustomed flavour. The authors think it doubtful whether the G-can method has any commercial advantage, but they recognise that their examination was merely preliminary. It may be suggested that should the G-can system be unsuitable for liquid milk or for dairying purposes it may nevertheless have a special value for milk intended for other manufactured products.

Control

In times like these we do not wish to criticise our Government; on the contrary, all of us wish to put forward every effort to bring about a speedy

and successful conclusion to the war. There is, however, always present the danger of bureaucracy crowding out common sense, and in certain sections of the food industries there seems to be rather an overdose of control.

Take for instance the organisations which are directing the grain and flour trades. They comprise the Board of Trade, the Ministry of Food, the Wheat Commission, the Flour Mills Control Committee, the Cereals Control Board, the Cereals Import Committee, the Cereals Advisory (Defence) Committee, the Imported Flour Department, the Ministry of Agriculture and Fisheries, the Ministry of Information, Port Area Committees and Local Committees. There may be others, but these are enough. Each of these is issuing orders and notices to a hard pressed and harassed trade.

Apart from the direct orders from these, shall we say, domestic committees, there are the notices general to all industry, such as transport, petrol rationing, etc. Doubtless all these committees and departments are seriously minded and enthusiastic, all seeking to do the best possible for the country, but it must be remembered that a miller has something more to do than fill in a multiplicity of forms and digest dozens of orders which are not all couched in the simplest of language. It would surely be a far better plan to have all the orders and regulations from these different committees centralised in one final body, which would then cement them all into one coherent scheme which could be translated into language which millers would be able to understand. At the beginning of things we do plead for simplicity and uniformity in the control of industry so that it can go ahead with its normal tasks without having to waste time and temper in extricating itself from a barrage of red tape.

In this connection a leading article in the *Farmer and Stockbreeder* is very illuminating: "When war breaks out it is not to be expected that organisation for agricultural development and control can work smoothly immediately after an emergency measure has been passed. But we have now had a month of war conditions and it has become obvious not only that much remains to be done but that the progress falls short of what it should be. . . . Prices of feeding stuffs were fixed, but we hear from all sides that they have, as a matter of fact, increased. This entails an offence against the Defence Regulations, but it is, apparently, no one's job to do anything about it. The whole business is in a thorough muddle".

The journal we have quoted is generally mild and conciliatory in its tone, and we feel that things are not all right with agriculture when it is compelled to express its views so strongly. As we said above, we do not wish to criticise, but we do want things to be put on a proper basis and useless overlapping and confusion ruthlessly stamped out.

Research

Just after the outbreak of war we were astonished to hear the view expressed that in these times of stress research organisations in the food industry were an expensive luxury and ought to be suspended. We agree that the life of the Industrial Research Associations has been limited to peace times and we have not had experience of them during war time, but it must be realised that it was during the last war that problems arose which could not be solved, and the situation created by these led to the initiation of the Research Associations. Far from being suspended, the research activities should now be redoubled as we shall undoubtedly be confronted with many problems that will require careful investigation if the war lasts any length of time. For example, problems of unusual storage will arise, and there may be much spoilage and waste if care is not taken. Then we shall have all sorts of substitutes suggested for various commodities. Shortages may occur, and these must be bridged over rapidly and with the least inconvenience to the public. In the food industry, particularly, the man in the street must never be allowed to think that he will be short of food. Research Associations, by virtue of their intimate and often confidential information, will be able to help manufacturers considerably. They will provide a central body which will tend to unify the industry. Competition between manufacturers must now disappear, and all should co-operate together for the common weal. Research Associations form the obvious link between manufacturers and Government departments, and if used freely many misunderstandings may be avoided. Therefore we say that the Research Associations must go on with even greater momentum than before. We are proud of those in connection with the food industries, and feel sure that the experience gained in the past will prove of great value to the Ministry of Food and food manufacturers all over the country.

Night Baking

It is surprising to see how persistent the opponents of night baking are in their efforts to have the system abolished. They have now pounced on

the blackout as an excuse, and Mr. Banfield asked the Home Secretary whether, in view of the severe hardship now being experienced by night bakers owing to the absence of ventilation due to the blackout, he would consider prohibiting night baking between the hours of 6 p.m. and 6 a.m. Sir John Anderson, in reply, stated that he had instituted special inquiries, from which it appeared that while conditions as regards temperature and ventilation were, in some cases, adversely affected at first by the blackout arrangements, they are now being improved. He said that on the information before him he did not think that such new factors have arisen as would justify the prohibition of night baking at the present time.

We entirely agree with Sir John Anderson. There are many other industries than baking where night work has been seriously incommoded by the blackout, but they have had to accommodate themselves to the changed circumstances. Ventilation can always be remedied by the judicious use of fans and air conditioning.

Whatever may be the case for or against night baking, it seems rather unfair to try to make the compulsory blackout an excuse for accomplishing a procedure which had been rejected after careful consideration in peace time.

Goodbye, National Mark

The National Mark system has had a lot of criticism in the past, and doubtless it has not been a complete success in some directions. On the other hand, it has done a great deal of good and has been responsible for the setting up of standards of excellence for many products. Now, like the Empire Marketing Board some years ago, the scheme is to be scrapped. In the House of Commons on September 21 the Minister of Agriculture was asked if he would arrange for the employment of women inspectors to replace male inspectors formerly employed in the National Mark scheme, so that the high standard and commercial goodwill attached to the mark through many years' work should not be wasted. The Minister regretted that, owing to the control to which supplies of various commodities must necessarily be subject in time of war, it was not possible to continue the National Mark grading schemes. It seems difficult to understand why it is not possible to keep the scheme going, at any rate in respect of fruit and vegetables. We realise the difficulties in the case of butter and eggs, which will probably be rigidly controlled, but if only a nucleus of the scheme is retained its complete reinstatement when the war is over will be far easier than it will be if the scheme is dropped altogether now.

Corned Beef

We have, in these columns, frequently commented upon the properties of corned beef as an economical and valuable food. Lord Luke, presiding at the Thirty-Fifth Annual Meeting of Estates Control, Limited, on October 11, pointed out that a 6-lb. tin of corned beef sold to the consumer at 5s. was equivalent to 15 lb. chilled or frozen beef, the cost of which, sold over the counter, could be estimated at 13s. 9d. The difference in weight was due to absence of bone and loss of moisture during manufacture. Hence, not only did this beef reach the consumer at considerably under half the price of the chilled meat, but it was already cooked, and fuel and labour were saved.

Unfortunately, the increased cost of the cattle required for corned beef, though low-priced compared with the younger chilled-beef cattle, did not permit of a profit on the production of this very economical cooked meat, although factories producing chilled beef could, out of their profits, subsidise their corned beef.

There was usually a very considerable sale for corned beef (continued Lord Luke), and at present it was in a unique position as regards shipping, as it occupied one-third the space of frozen beef and did not need cold storage compartments on board ship.

The unfortunate feature of the matter was that at present there was nothing to encourage the manufacture of corned beef; much less is being produced, and brands of corned beef which have been well known for forty years would soon have completely disappeared from the shops. Lord Luke suggested that, although no doubt the corned beef taken from the market was required in some new direction, the matter should be dealt with carefully, otherwise the poorer people might be deprived of the only beef they could afford.

We feel that there is ample scope for examination of this important matter. Are there no ways or means whereby the manufacturers of this valuable food product may earn a fair and reasonable profit?

Packaging in War Time

That the effect of the war on the packaging industry is not to be viewed from a pessimistic standpoint is suggested by an editorial in *Packaging Review*: "Packaging in its various forms is

largely bound up with distribution and, so far as general commodities are concerned, there is no question but that distribution is just as essential during war as in peace time. The manufacture of boxes, cartons and containers and the packaging and canning of foodstuffs and other products essential to the life of the nation will have to be maintained at rates comparable with, if not in excess of, the pre-war basis ".

The writer points out that present conditions may have an adverse effect upon the artistic side of packaging, but even here any cessation of development will probably be only temporary in character, as trade competition will again cause demands to be made on the services of the designer and the producer of the artistic pack.

We feel that, within limits, this is as it should be. Artistic packaging is now a part of our system and has functions other than that of selling goods. It is part of the cult of beauty. Doubtless a lot of this must be sacrificed in the process of fighting for a world in which this and other seemly things will have a firm place, but if we can retain what we can, so much the better.

The packaging of food, among other things, may undergo considerable modifications from a utilitarian standpoint, and offers a big field for inventiveness. There will doubtless be the protective covering against gas. There will be modifications in materials used. The need for economy will be a spur to research. Availability of specific materials will be a factor which may be a varying one. But, faced with modern methods of food distribution, the packaging experts will find themselves exceedingly busy, superimposing new methods upon conditions which may be rendered obsolete for the moment.

Anti-Profiteering Legislation

The Prices of Goods Bill, which at the time of going to press is being considered by Parliament, is aimed at profiteering in the sale of essential commodities.

The Bill does not specify the particular kinds of goods to which it will apply, this matter being left to the Board of Trade, who from time to time will make orders indicating the kinds of goods of which the prices are to be controlled. Such classes of goods are described as " price-regulated goods ".

The method adopted for the purpose of regulating prices is simple in principle, though in its application to particular cases it may prove to be extremely difficult and involved. It begins by determining the " basic price "—that is, the price at which similar goods were being offered for sale in the course of business as at August 1, 1939. If, however, owing to exceptional circumstances or seasonal variations in prices the above date would not be an appropriate date, it is open to the Board of Trade to select some other date, by reference to which the " basic price " is to be determined. The " basic price " may then be increased. The matters to be taken into account in fixing the permitted increase are specified in the First Schedule, and they include the cost of material, manufacturing expenses, the cost of premises and plant, maintenance, expenses, rent, insurance, wages and salaries, customs and other duties, rates, interest on loans, transport charges, advertising expenses and certain other matters. The Board of Trade, however, are empowered to add to the matters specified in the Schedule, which are to be taken into account in determining price increases.

The " basic price " plus the " permitted increase " that is ascertained will constitute the " permitted price "—that is, the maximum price at which the goods may be sold.

It is quite obvious that uniformity of price is highly desirable. It would be extremely inconvenient, for example, if A were selling price-regulated goods at say 5s. and B selling them at 5s. 6d., then the question would repeatedly have to be examined as to what was in fact the " permitted price ". Provision is therefore made by the Bill for the making of applications to the Board of Trade by bodies of persons who are representatives of traders in goods of the particular descriptions concerned.

If any such application is made, the Board of Trade is empowered to make an Order determining the basic price, the standard permitted increase, and even the price representing the permitted price for goods of the particular description. There is a right of appeal to a Referee, however, against any such Order made by the Board of Trade.

It is an offence of course to sell goods at a price exceeding the permitted price—*i.e.*, the basic price plus the permitted increase—nor may the Act be evaded, by means of collateral transactions, such as required the purchaser to buy at the same time goods which are not price-regulated goods; nor by the holding up of stocks and the creation thereby of artificial increases in values. Thus a trader may not, in the absence of reasonable grounds for doing so, refuse to sell a stock of price-regulated goods, if an offer to purchase them at the permitted price together with a tender of immediate payment therefor is made by an intending purchaser.

JUDGING QUALITY IN DAIRY PRODUCTS

The instruments of the future may be able to measure the physical properties which he needs to know with far greater accuracy than can be done by hand, but the expert will still control the processes at will and dairying will have become a science without having ceased to be an art.

G. W. Scott Blair, *M.A., Ph.D., A.I.C.*

DAIRYING is one of the few of our basic industries in which the control of the principal manufacturing processes and the valuation of the finished product still depend, to a large extent, on individual craftsmanship. Even in the bread-making industry the introduction of machine baking is resulting in less and less significance being attached to the judgment of individual bakers, and in ceramics chemical and physical tests are gradually replacing the rule-of-thumb methods of an earlier age.

Mechanisation in Industrial Testing

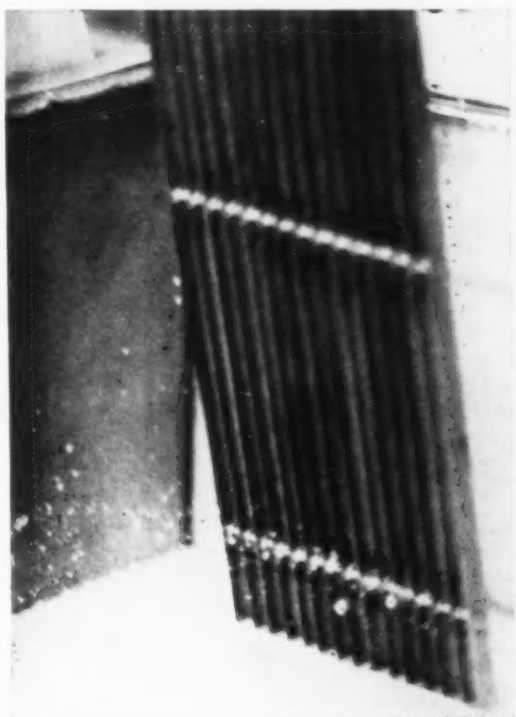
Generally speaking, scientific tests for materials are introduced in industries where (1) the raw materials, intermediates and finished products have comparatively simple physical or chemical properties, and (2) the industry is organised on a factory scale and the products and sometimes the raw materials have to be transported over considerable distances. A cottage industry, selling directly to its neighbours, relies on the personal judgment of one or two craftsmen, since complaints and suggestions can be dealt with personally, whereas a more objective standard is required if correspondence has to be conducted over a wide area.

There is much to be said for craftsman-control. Many desirable or objectionable properties of materials can be observed by an expert which are not yet sufficiently understood to be interpreted at all simply in terms of chemical composition or physical properties, and a few very important factors, such as aroma, cannot yet be in any way assessed by quantitative laboratory methods.* But the principle also has its dangers. Few businesses can afford to keep more than a very limited number of highly skilled experts, and should these not be available because of illness or other cause, less skilled men may be unable adequately to replace them. In war time this is a matter of special importance. Moreover, the training of younger men is extremely tedious if no adequate explanation of the bases of judgment can be given, and even when a machine cannot adequately replace the craftsman, comparison of judgments with objective tests has been shown to increase the speed of learning,[1] which is also an important factor in these days. It is important that it should be clearly understood that there is no intention of belittling or attempting to displace individual experts—on the contrary, the suggestions which follow should serve as an aid to them, as well as to the industries employing them.

The dairy industry is rapidly becoming centralised and, being regarded as a "factory" industry, will be faced with the question as to how far methods of standardisation such as have been applied to steel, concrete, cotton or oil can be developed for products such as butter and cheese. To-day no engineer will build a bridge or make a gun without first specifying the strength of his steel; oil is graded on the basis of such properties as viscosity, and fibres are tested for tensile strength.

Mechanical Properties of Dairy Products

It might be argued that such materials depend for their quality on their physical properties, whereas in dairy products nutrition value is all-important. The



The cutting of cheese curd in the vat. The time at which it is believed to be correct to cut the curd is judged by the expert by handling the material.

* *Although experiments are in progress directed towards such measurements.*

evidence of recent research is, however, against this point of view. The "strength" of a flour, for example, which is certainly related to the "goodness" of the bread, is better measured from the mechanical properties of its dough than by chemical analysis,[2] and changes in behaviour during "proofing", although of great importance, cannot be followed with any accuracy except by physical tests. The flavour of a cheese depends to a large extent on the type of micro-organism which flourishes in it, and this is largely controlled by the mechanical properties of the medium. Even the best flavoured butter is unpopular and wasteful if it is too hard or brittle to spread.[3] The craftsmen have long realised this, and a high proportion of marks given for quality in bread, butter or cheese are given for properties such as "body".

Can Instruments Replace the Hand?

How far, then, will it be possible to construct instruments to measure the "body" and texture of dairy products? Will the viscosity of cream prove as useful a criterion as did the viscosity of oil? Can the various stages of cheese manufacture be controlled by machines to replace or supplement the hand of the cheese-maker?

In attempting to answer these questions, two facts must be borne in mind. First, the physical properties of materials such as cream, butter and cheese are generally far more complex than those of steel or oil. Only gradually are these properties coming to be understood as the more complex phenomena of rheology* are elucidated. Thus recent advances in the knowledge of the structure of rubber[4] have not only increased standardisation in the rubber industry, but will throw valuable light on future methods applicable to dairy research. Secondly, the mechanism by which craftsmen form their judgments, and especially the manner in which they utilise previous experience in interpreting the data of their senses, are only beginning to be investigated. Our aim is, then, to find out (*a*) what physical properties of a material are of real importance in assessing its quality, (*b*) how to measure these physical properties, (*c*) how accurately and reproducibly they can be assessed by the craftsman handling and examining the material, and (*d*) to help the craftsman either to improve his accuracy or to pass on his skill to others with greater ease than heretofore.

Cheese Curd an Elastic Solid

In a few cases the task is not difficult. Thus cheese curd prior to cutting has been found[5] to behave very nearly as an elastic solid for small deformations, and an apparatus has been constructed for measuring its elastic moduli. By comparing the firmness of the curd measured in this way with the opinions expressed by skilled cheese-makers, it has been possible[6] to assess the accuracy with which differences in firmness can be judged. It appears that, although a confident opinion is often given about very small differences in firmness (of the order of $\frac{1}{2}$ per cent.), the smallest difference which can be appreciated with any degree of certainty is of the order of 8 per cent. In the factory where the tests were carried out it was believed by the cheese-makers that Cheshire and Double Gloucester curds were cut softer than Cheddar, whereas in reality no significant difference was observed during the course of a year. During this period the cheese-makers did not consciously change the firmness at cutting with the season, but it was shown that curds described as "normal", regardless of type, were, in fact, softer in summer months than in the winter. A technique has been described[7] for measuring the elastic and plastic properties of cheese and butter, the effects of mastitis milk, for example, being clearly demonstrable from the data obtained for cheese. Attempts have also been made[3] to interpret the spreading properties of butter in terms of viscosity, and many of the complex properties of butter (some of which, such as strain-hardening, were first studied in metals) are being investigated. Some creams behave like oil[8] and show simple viscous properties, some show fairly simple anomalies known to exist in other industrial materials, whereas homogenised and reconstituted creams, especially if not very carefully prepared, show flow-properties as complex as those of any industrial material yet investigated.

Most of these researches have been done at the National Institute for Research in Dairying, since the properties of dairy products are of such immediate importance in maintaining and improving the standard of the national food supply, nor has the Institute forgotten the other aspect of the problem—namely, the fundamental study of the way in which craftsmanship works in the industry.

The Psychology of Cheese Testing

At first sight it all seems so simple. The cheese-maker, for example, bores a cheese, squeezes the plug

A later stage in manufacture in which subjective judgment is also made. The cut curd is being squeezed in the expert's hands to see whether it is ready for "pitching"—i.e., for the curd to be allowed to sink to the bottom of the vat.

* *The science of the deformation and flow of matter.*

with his thumb on the iron, or removes the plug from the iron and bends it in his fingers,* and then expresses an opinion: "This cheese is rather too soft and springy". We do not wish to appear to be like the centipede, who got into such difficulties through attempting to introspect on the apparently simple process of walking, but it must be realised that the nature of the judging process is of very great importance if we are to understand anything of the nature of skilled testing.

First of all, has the cheese expert any greater acuity—*i.e.*, any more developed sense of touch than other people? Could he distinguish smaller differences in elasticity of elastic bodies than could the layman? For comparatively simple materials like rubber[9] and bitumen[10] it appears that he cannot, and still unfinished experiments on more complex cheese-like materials appear to bear out the opinion that his "sense of touch" is not abnormally acute. This finding is in agreement with the results of rather similar experiments on the skilled judging of wool-tops.[11]

Cheese, like metal, strain-hardens, so that if pieces of two cheese (A and B) are compared by squeezing, if A strain-hardens more than B, although it may be initially softer than B, it will appear harder, when the squeezing has proceeded for some distance. Also, if we compare the firmness of two cheese, one of which is "elastic" and the other comparatively "dead", our judgment will be considerably influenced by how long we go on squeezing. The longer we squeeze, the softer (relatively) will the "dead" sample appear to be.

For these and other reasons it seems likely that an important factor in judging cheese (and, of course, the same applies to curd in various stages of manufacture) would be the capacity of the tester to reproduce from test to test the movements of the fingers both with respect to amount and rate of movement. For reasons too complex to discuss in this short article, pressure constancy is also of great importance.

It is hoped soon to publish the results of some experiments that bear on this question. In the meantime it is of interest to consider the problem in the light of earlier work on the nature of skilled movements.[12] How, for example, does the skater control the extremely elaborate series of muscular reactions required to carry his body safely and gracefully through a complex figure? How do the traces of his figures on the ice come to have an almost perfect resemblance to each other? How easy would it be for him, at a certain point in the curve, to digress, and proceed to copy, perhaps, the irregular figures of a less skilled performer? It is certain that the skater himself cannot answer these questions adequately, and yet his many experiences have produced some organisation stored up in his unconscious mind, which unthinkingly helps to control his reactions. Each stage in the process depends on what has gone before, the whole being a curious mixture of determinate activity, interspersed with originality, sometimes consciously willed. No figure is ever quite the same as the last. No pianist ever gives quite the same rendering of a prelude twice, and yet in broad outline the good pianist shows less variation than the unskilled beginner who plays different wrong notes each time. Craftsmanship must be associated with some curious blend of flexibility and inflexibility of performance. Without the former there could be no originality, and without the latter no technique.

* *The procedure naturally differs in different localities and depending on the type of cheese.*

An expert judging a plug of cheese as described in the article.

Judging Materials

In judging materials the expert makes a comparison, sometimes between sensations derived from two sources simultaneously (as when he squeezes a piece of cheese in each hand) and much more frequently between an immediate sensation and the image which he unconsciously bears in his mind of some earlier sensation. In this way he "recognises" conditions which he has, on previous occasions, learned to associate with good or bad qualities. This power of recognition is of great importance in craftsmanship and deserves further study.

Many cheese-makers find it hard to restrict their judgment to one field at a time. For example, if asked to compare two cheese for body alone, they cannot resist being influenced by aroma or colour. The expert is often not fully conscious of his own difficulties in this respect, and sometimes even more remote factors influence his judgments, such as the cleanliness of the dairy, or the charm or otherwise of the dairymaid. Far be it from us to belittle the importance of these things, and doubtless personal charm and clean surroundings all go to the making of a good cheese, but it is clearly desirable to judge each factor on its own merits as far as possible.

Finally, there is the undoubted capacity of the expert to know how to use the information which his senses give him and which his mind interprets for him. The poet said, "Enough, no more! 'Tis not so sweet now

(*Concluded on page* 365)

MILK POWDER
SOME MODERN DEVELOPMENTS

The recent rapid growth of milk drying, particularly by the spray process, may well prove an important national asset in the present conflict. As yet milk powder has hardly penetrated the domestic market, except as a constituent of infant and patent foods, and the general public has yet to discover its great value. E. L. CROSSLEY, *B.Sc., A.I.C., F.L.S.*, here discusses some of the latest developments—and some problems arising therefrom—in the production of this interesting product.

THE BRITISH DAIRY INDUSTRY is destined to play a vital part in the maintenance of our food supply under war conditions, and the manufacture of milk products which can be stored will undoubtedly be of great importance. During the conflict of 1914-1918 milk drying in England was little developed and almost confined to the roller process, so that reliance had to be placed upon the manufacture of sweetened condensed milk and sterilised evaporated milk. Dried milk powder constitutes an excellent alternative to these products, and is in many respects superior, so that the recent rapid growth of milk drying in this country, particularly by the spray process, may well prove an important national asset.

As yet milk powder has hardly penetrated the domestic market, except as a constituent of infant and patent foods, and the general public has still to discover its great value. Of all forms of preserved milks, spray process milk powder offers the nearest approach to raw milk in composition, flavour, nutritive value, and vitamin content. The powder keeps well for many months, and is readily dissolved in cold water to yield a reconstituted milk which closely resembles raw milk. In addition to superior nutritive value, such reconstituted milk is almost free from the pronounced cooked flavour characteristic of tinned milk, and the absence of added sugar (as in condensed milk) may sometimes be an advantage. Moreover, reconstituted milk may be prepared from powder in large or small quantities, and of varying concentrations to suit the needs of special diets or infant feeding; for such purpose it is now widely favoured by the medical profession.

An excellent discussion of the chemical and bacteriological aspects will be found in a review by Allen[1] and of engineering problems in a companion review by Scott.[2]

The Roller-Drying Process

Until recent years the manufacture of milk powder in Great Britain was almost entirely carried out by the "Roller" process, in which the milk is spread as a thin film over the surface of revolving steam-heated metal rollers. The dried milk is removed from the rollers by means of scraper knives and forms a thin sheet which is readily sifted. The film of milk does not approach the temperature of the steam, which is usually employed at 290° to 300° F., whilst the period of heat contact is only about 3 seconds, but nevertheless the heat treatment proves somewhat severe, especially when added to the effect of previous preheating (usually at 160° F.). Consequently some protein coagulation occurs, resulting in a powder of only 80 to 85 per cent. solubility.

On the other hand, the heat treatment brings about pronounced destruction of bacteria and deleterious enzymes; good roller powder should not contain more than 20,000 bacteria per gram, which are mainly spore-forming species unless excessive atmospheric contamination occurs in subsequent processes.

Although it yields powder inferior for most purposes to spray-dried powder, the roller process is still deservedly popular. This is due to the fact that the process is cheap in operation, economical of floor space, and fairly low in capital cost. Moreover, it may be employed to deal with comparatively small quantities of milk, the standard plants being designed to handle from 50 up to 250 gallons of milk per hour. Roller-dried powder is extensively used in the preparation of infant foods, chocolate, and cattle foods.

Some degree of finality in design is now apparent. Enclosure of the rollers in a vacuum chamber enables lower temperatures to be employed, resulting in improved solubility, but in practice operational difficulties arise. Otherwise efforts have been directed mainly towards increased efficiency, obtained by feeding precondensed milk on to the rollers and also by utilising the hot vapours rising from the drum to preheat the incoming milk.

The Spray-Drying Process

In this system the milk is atomised and sprayed into a large hot air chamber; a large surface area is exposed and drying is almost instantaneous. The heated air serves the double purpose of supplying heat for evaporation and also carrying away the evolved vapour, whilst the dried milk falls to the base of the chamber as a very fine powder which needs no grinding. Precondensation is not essential, but is usually employed, since considerable economy is thereby obtained and production of excessively light, bulky powder is avoided. Concentration is usually carried to about 40 to 45 per cent. solids, and immediately after leaving the evaporator the concentrated milk is sprayed into the drying chamber; the temperature of the concentrated milk varies from 120° to 165° F. in different makes of plant. The temperature during drying is under close control and can be kept below 140° F., thus avoiding the overheating of roller drying. Whilst direct measurement is impossible, it

appears likely that the temperature attained by the milk may not greatly exceed 110° F.

The spray process yields a superior product of almost complete solubility, ranging from 95 to 99 per cent. Two serious drawbacks have considerably delayed development in Great Britain. Firstly, the capital cost is very high, both of the plant itself and the very large building required to house it. Secondly, the process is not an economic one at present unless very large quantities of milk are handled; spray-drying plants must in consequence be kept running 18 to 24 hours per day and may handle 500 gallons of milk per hour. These difficulties are being solved by the concentration of dairy manufacture in larger units owing to absorption of small firms by the larger companies. There are still only about seven plants in this country, but these have a very large output and the spray-dried product is rapidly gaining favour. Spray-dried skim milk powder is also produced in very large quantities for the baking trade and as an ingredient of balanced ice-cream mixes.

Problems of Design

The various makes of plant exhibit very wide differences in design, which implies that finality is not yet reached. High temperatures during preheating and precondensing adversely affect the solubility of the final powder. For the same reason, the milk temperature during drying must be kept as low as possible, but economic operation demands the highest possible air temperature. Drying must be completed in the shortest possible time, but the size of the drying chamber, already very large, must be confined to reasonable dimensions.

In some plants (*e.g.*, Merrell-Soule and Rogers) a horizontal pressure jet atomiser is employed in conjunction with a rectangular drying chamber, whilst the Gray-Jensen system uses a revolving pressure jet and a conical chamber. Such pressure jets produce a conical spray, and apart from certain operational troubles the chief criticisms advanced against them are that perfect mixing with the hot air is difficult and that the particles are not uniform in size—both of which encourage uneven heating. Other plants employ a high-speed rotating horizontal disc which produces a curtain-like mist; such a disc atomiser may be used in conjunction with an upward air current (Krause) or with a spiral downward current in a conical chamber (Kestner). Disc atomisers are easy to clean and operate, but tend to wear rather rapidly owing to their high speed. The particles produced are uniform in size, and, moreover, by adjusting the disc radius and speed of rotation the size of the particles (and hence the bulk density of the powder) can be varied.

Other problems arise in connection with air currents, removal of powder from the drying chamber, and extraction of powder dust from the exit air. Until recently it was not fully realised that long exposure of the milk powder to contact with hot air adversely affects both the solubility and the vitamin content. Rapid removal from the hot air zones is essential, preferably by a strong downward air current. For the same reason, the proportion of powder to be collected from the exit air current by means of filter bags should be as small as possible. In the Kestner plant an intermediate cyclone separator follows the drying chamber, leaving only 1 to 2 per cent. of powder to be extracted by the bag chamber. The Gray-Jensen system dispenses entirely with filter bags, the incoming milk being sprayed through the exit air and the powder dust thereby redissolved; furthermore, the heat carried away by the outgoing air (which may be 50 per cent. of the heat applied) is used to preconcentrate the incoming milk, although a rather high-working temperature is necessary. In all cases removal of powder should be carried out in a closed conveyor system to prevent atmospheric contamination and to avoid powder dust in the building.

Bacteriological Problems

Previous literature on the bacteriology of milk powder has almost been confined to the roller-dried product. A preliminary paper by the author[3] and a paper just published by Miss A. A. Nichols,[1] of the Hannah Dairy Research Institute, have dealt with spray-dried milk, and this work shows that the two types of powder differ very widely. The difficulties of bacteriological analysis are considerable, but it is only possible to remark here that an agreed standardised procedure is urgently needed.

The numbers of bacteria may vary from less than 1,000 up to many millions per gram of powder. In contrast with roller powder, the bulk of the flora consists of harmless thermoduric cocci; the commonest species are probably *Str. thermophilus* and *Str. durans*. These organisms survive heating at 145° F. for 20 to 30 minutes, and produce an acid coagulation in milk. Coliform organisms are very occasionally present in very small numbers, but are frequently heat-resistant strains. Small numbers of spore-forming species, aerobic and anaerobic, are also encountered. Yeasts and moulds are rare, and if present in numbers are an indication of packing contamination or bad storage conditions. The total numbers of bacteria present appear to vary enormously, not only between powders produced from plants in different factories and localities, but also in the product of the same factory. Nichols has observed that during the summer months, when difficulties of bacteriological control are greatest, the powder produced by certain factories showed a high bacterial content. On the other hand, powder produced by factories maintaining close scientific control showed little seasonal variation.

The author has investigated the manufacturing problems which affect bacteriological quality, and concludes[3] that, although the drying process does destroy large numbers of bacteria, the final results are largely determined by the preceding operations.

High Bacterial Counts

High bacterial counts in spray powder may sometimes be due to the presence of large numbers of heat-resistant bacteria in the raw milk supply. The species of cocci concerned occur commonly in raw milk, but their numbers are increased still further by poor cooling on the farm and wrong handling of milking machines, whilst the factory may contribute to the trouble by prolonged storage of the raw milk before drying.

Efficient pasteurisation of the milk is the foundation of success. This process probably influences the final result more than any other, and the closest attention must be paid to temperature control. Thermoduric cocci survive pasteurisation in varying numbers, depending upon the temperature employed and the raw milk flora. These organisms could, of course, be killed by using high temperatures, but this procedure results in reduced solubility of the powder, and in practice temperatures over 165° F. are undesirable, whilst the total heat treatment should not greatly exceed the equivalent of 145° F. for 30 minutes.

Following pasteurisation the milk is usually concentrated four to five times, and most modern plants now employ calandria type evaporators. With very close control it is possible to obtain excellent bacteriological results, but in practice variation occurs and contamination may sometimes be considerable. The accumulation of milk film, together with the large surface area to be cleaned, constitute serious difficulties which render cleansing and sterilisation by no means easy. Concentration is usually effected at 110° to 120° F., except in the Gray-Jensen plant wherein the process previously mentioned is carried out at 160° to 165° F.

In addition, the large size of a spray-process plant may involve the use of long pipe-lines, and also a number of holding tanks necessary to ensure a regular feed to pasteuriser, evaporator, or drying chamber. Care is required to avoid contamination from such sources. A further special danger must be mentioned. The presence in the plant of stagnant pockets of hot milk, or long holding of milk at a high temperature in supply tanks, may lead to rapid infection of the plant with large numbers of thermophilic bacteria able to multiply at high temperatures. Such strains of *B. calidolactis* have been known to cause acid curdling of hot milk standing in holding tanks, and in the author's opinion hot milk should not stand more than 20 minutes awaiting entry to evaporator or drying chamber.

The final hot-air drying destroys many bacteria, although the reduction is less than in roller drying due to the lower temperature. During a long drying run there is frequently a steady or sometimes considerable increase in the bacterial content of the powder, due probably to accumulation of film on heating surfaces and also to storage of the raw milk. Some atmospheric contamination may occur during sifting and packing; such contamination generally constitutes only a small proportion of the total bacterial content of spray powder, but may form a large proportion in roller powder. Excellent bacteriological results will follow careful attention to the above points.

Keeping Quality and Storage

The low moisture content of milk powder prevents bacterial growth and decomposition, although the bacterial content becomes of great importance when the powder is reconstituted to liquid milk. A good milk powder should keep 12 months, but eventually slow chemical changes take place in the fat portion, usually more rapidly in spray than roller powder. Lipolytic enzymes may sometimes remain active in spray powder and bring about rancidity by hydrolysis of the fat. The commonest defect, however, is "tallowiness" caused by oxidation of the oleic acid portion of the fat. This oxidation occurs in both spray and roller powders, but the precise influence of the factors involved is still somewhat uncertain.

The presence of traces of metals, particularly copper, undoubtedly hastens the trouble. High acidity, high storage temperatures, and high moisture content are further probable causes. Certainly moisture contents over 5 per cent. are deleterious, resulting also in loss of solubility and "stale flavour". Air-tight packing is also important, since oxygen is necessary for the process.

Bacteria tend to die out during storage, but the rate of decrease is variable, the author having obtained counts from 5 to 22 per cent. of the original after 12 months' storage. Nichols reports an average reduction of 95 per cent. after 12 months at room temperature.

Essentials for successful storage are therefore an air-tight container, low temperature, and low humidity (since milk powder absorbs moisture rapidly). The keeping quality may be further increased (up to three times or more) by storage under vacuum or preferably neutral gas such as nitrogen. This method is most valuable, but naturally increases production costs and requires an air-tight metal container, which precludes the use of cheap packages.

Nutritional Value

Much controversy, not altogether free from commercial considerations, has taken place concerning the relative nutritive values of spray powder, roller powder and evaporated milk. Any changes present in pasteurised milk must also be present in each of the three; beyond this spray powder receives only low-temperature heat treatment, roller powder rather greater heat treatment, and evaporated milk very severe heating. The facts have now been clearly established as the result of any exhaustive investigation of the three products just completed by workers at the National Institute for Research in Dairying.[5] The results demonstrate the remarkable nutritional value of spray-dried milk, which was slightly superior in all tests. The main conclusions were: (1) Biological values of the proteins were roughly equal, (2) the digestibility of evaporated milk was less than roller or spray powder, (3) vitamin A remained intact, vitamin B of evaporated milk was only half that of milk powders, whilst vitamin C showed 20 per cent. less in spray drying and 30 per cent. less in roller drying and evaporation, (4) rat-feeding experiments indicated that powder was superior to evaporated milk.

Roller powder has been preferred in the past for infant feeding owing to its better keeping quality and lower bacterial content, but recent advances in spray drying are rendering these arguments less tenable.

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PRECISION METHODS IN ARC WELDING

Development of the Sheet Expansion Micrometer and the Use of Dry Ice (Solid Carbon Dioxide) in Progressive Cooling in the Manufacture of Milk Pasteurisers

The author of this paper received an award in the Food Making Division of the Industry Machinery Classification of the $200,000 Program sponsored by the James F. Lincoln Arc Welding Foundation, Cleveland, Ohio, in which large savings were shown to be available to industry by wider application of arc welding.

NELSON M. FULLER

THE problem discussed in this paper deals with improvements in the arc welding of stainless steel food containers, and particularly with milk pasteurisers. While the solution presented is intended especially for the improvement in the art of fabrication of such containers, nevertheless it is possible that the control of expansion obtained by this method may have numerous other applications in the welding industry wherever the use of thin stainless steel sheets is desirable, or other alloys which may be used, as in airplane fuselage construction.

Design of Pasteurisers

It seems desirable to describe in a general way the design and operation of milk pasteurisers and some of the physical phenomena involved in their construction and operation. A pasteuriser is a simple machine consisting of an enclosed tank surrounded by an outer tank through which hot water or steam is circulated for the purpose of heating the contents of the inner tank. Some form of agitation is provided for in the inner tank. Outlet valves of a special type are provided at the lower edge of the inner tank.

Milk is said to be properly pasteurised when every particle of it is heated to a temperature of 143° F. for a period of thirty minutes. It is improperly pasteurised if the temperature during this period is less than 143° F. or more than 145° F., or if it is heated less than 30 minutes or more than 30 minutes. In other words, to be pasteurised, milk must be quickly heated to its pasteurisation temperature, held 30 minutes at that temperature, and then rapidly cooled in the vat to about 120° F. It is further cooled and bottled by the use of other equipment.

Effect of Milk on Metals

Milk contains physiological salts which attack many metals, and even though present in extremely small quantities, the metallic compounds formed impart an objectionable flavour to the milk. Copper, for instance, causes milk to have a cardboard taste in concentrations as low as one part of copper to a billion parts of milk. It has been found that milk is unaffected by stainless steels, and for that reason stainless steel has become an almost universal alloy for use in the fabrication of pasteurisers. In addition, it has other advantages: it is a hard, dense alloy which takes a high polish and does not scratch easily, and does not wear. From the standpoint of sanitary bacteriology, these are desirable qualities which permit easy cleaning and sterilisation of the surface.

During the cleaning operation, pasteurisation tanks are filled with hot water at 180° to 200° F., or in some cases live steam is applied through the outlet valve. Steam may be added directly to the hot water in the vat also, and the resulting vibration puts a terrific strain upon the seams of the vat. Hence, the processing and cleansing operations result in subjecting the pasteurisers to wide variations of temperature and vibrational stresses. Any strains set up in such vats at the time of welding as a result of the heating add to the normal expansion and contraction forces which occur daily. The failure of welded joints in such pasteurisers is not uncommon.

Type of Stainless Steel for Pasteurisers

Stainless steel of the type used in pasteurisers has a very high tensile strength and is reasonably ductile. For that reason, attempts to fabricate pasteurisers with the thinner gauge steel were attempted. However, when gauges as thin as 20 or 22 were tried, the tremendous expansion of the material during the welding process made it impossible to prevent serious buckling and out of roundness in such tanks. The only successful way such tanks were fabricated was to lap weld the bottom section and to fill in the crevices with a fillet of solder. In operation, the lead or tin in the solder dissolved, due to the electrolytic potential differences between the two alloys, and the resultant cracks in the solder caused many of this type to be condemned. It was soon found that the only satisfactory method of fabrication was the use of heavier materials, and 14- to 16-gauge steels were employed. The 14-gauge metal had sufficient strength to withstand the strains of expansion and contraction in the welding process, and such jobs could be butt welded. However, the use of the thicker steels required larger shop equipment for forming purposes, and increased the labour costs considerably.

Use of 14-Gauge Materials

Furthermore, the use of the 14-gauge materials reduced the conductivity of the alloy to one-third that of the 22- or 20-gauge steels (Table IV). This required a higher temperature of the heating medium than with the thinner steels in order to obtain the same relative heating time. Hence, there is a greater tendency for the milk to burn on the sides of vats when the thicker steels are used. Table IV shows the differences in conductivity of the common thickness of stainless steel now being used.

The added cost resulting from the necessity of using the thicker stainless steels causes a selling price on such pasteurisers which is nearly prohibitive to the small milk dealers. It will be seen from Table II that of the 3,111 pasteurisers sold last year, the average capacity was around 165 gallons, which clearly shows that the selling field for such equipment is in the so-called small dealer classification. It is important that the price of this equipment be reduced for economic reasons, especially in areas where milk pasteurising dealers have to compete with raw milk dealers.

Without attempting to discuss the increase in cost of labour on the 14-gauge equipment, it will be seen from Table III that the use of 14-gauge material increases the cost by more than $20 per pasteuriser.*

To some extent the use of modern arc welding methods has made it possible to work with 16- and 18-gauge materials in the fabrication of pasteurisers.

The use of the sheet expansion micrometer with dry ice in localised cooling, as described in this paper, permits the employment of 18- *and* 20-*gauge, and possibly* 22-*gauge, stainless steels for this type of product.*

The Problem Summarised

In summarising the problem, it appears that in all types of stainless steel pasteurisers, regardless of the gauge used, tremendous strains have been set up in the containers as the result of the expansion of the material during the welding process; that these strains occasionally cause failures in the joints in the course of continual use; that attempts to use 20- and 22-gauge stainless steels, although highly desirable, have not been successful, due to distortion as a result of expansion and contraction in the welding process; that the cost of the 14-gauge equipment is almost prohibitive for the milk dealer,† and that 20- and 22-gauge steels would materially improve the processing of the milk as a result of greater heat conductivity of the thin steel.

Need of Greater Precision

It seems clear that some method of controlling the expansion within reasonable limits would improve the art of making stainless steel pasteurisers. The idea of using more precise methods in welding pasteuriser tanks for the purpose of preventing the occurrence of objectionable strains in the welded products is desirable, and it would seem that means of observing the expansion and means of reducing, by controlled cooling, the contraction back to the original state as the welding progressed would solve this problem.

Development of the Sheet Expansion Micrometer

An adaptation of the dial micrometer appears to be the most satisfactory method of developing a suitable means of observing the expansion of the sheet, and for this purpose the body portion of a Starrett cylinder gauge was used. "Invar" steel alloy rods were inserted through the guide holes of the Starrett cylinder gauge. One of these rods, while otherwise free to move, is attached to the contact point of the gauge by a steel block and set screws. The other rod is locked in place by a set screw. Four supporting legs are provided, two of which are free to slide and the other two are equipped with special heat-resisting rubber (400° F.) suction pads. These suction pads are on alternate ends of the rods and are placed so that when firmly attached to the work by the suction of the pads, the movement of the sliding rod is registered in the dial of the micrometer as the steel sheet expands or contracts. In practice, two micrometers are used. Cooling is obtained by the use of dry ice (solid carbon dioxide) attached to a metal holder by means of freezing it to the bottom of the holder with a little water, which is poured through the hole in the bottom of the holder. The intense cold of the dry ice quickly freezes the water poured through the bottom of the holder, which then is firmly attached to the dry ice and remains so until the block of dry ice has disintegrated.*

Application

A cycle of the operation is described as follows: About a linear foot of weld is made at one time. Before the weld is made, the two sheet expansion micrometers are placed opposite the approximate centre of the weld and normal to the weld, one on the bottom, and one on the side of the pasteuriser under construction. Each micrometer is adjusted to the zero reading on the dial before welding commences. The weld is then made, and, when finished, the dial readings on the micrometers are noted, and then the block of dry ice is applied to the opposite side of the sheet expansion micrometer near the weld. The cooling action of the dry ice will quickly cause the steel sheets to contract, and when the dial readings of the micrometers return to the zero point, the blocks of dry ice are removed and the sheet expansion micrometers are then moved to the next location. Thus the temperature of the tank when finished is within a few degrees of being the same as when the work was started, and no objectionable distortion resulting from contractions occurs in the welded product. This is a simple method of obtaining a control of the expansion hitherto estimated by rule-of-thumb methods, and it makes possible the fabrication of pasteurisers with 20-gauge stainless steel.

* *The Oakes and Burger Mfg. Co., of Cattaraugus, N.Y., estimates labour costs to be increased by 31 per cent. when 14-gauge steel is used in place of 20-gauge steel.*

† *A 200-gallon pasteuriser constructed of 14-gauge stainless steel, manufactured by the Oakes and Burger Company, retails for $800, f.o.b. Cattaraugus. The same apparatus, constructed of 20-gauge stainless steel, retails for $610, f.o.b. Cattaraugus, N.Y.*

* *Cooling may be accomplished by other means: for instance, a flexible rubber bag connected by rubber hose to a brine cooling apparatus might be more adapted to cooling curved surfaces such as may be encountered in airplane streamlining work.*

Further, it reduces the strains now present in pasteurisers made of thicker gauge steels, and therefore greatly extends the life of equipment which I have previously shown to be daily subjected to severe strains from expansion, contraction and vibration.

Probably one of the greatest values of the device is that it arouses the interest of the welders in the expansion and contraction problem, and they develop a skill in using the equipment comparable to their skill in the use of the arc welder.

As an adjunct to the arc welding process, it makes possible more precise workmanship and solves in a practical and easy way the problem of expansion in the welding of stainless steel pasteurisers.

Summary

(1) The use of the sheet expansion micrometer makes possible a 31 per cent. saving in the cost of construction of stainless steel pasteurisers (see footnote, p. 362).

(2) The approximate gross savings to the industry for the particular product—namely, the fabrication of pasteurisers from stainless steel by the precision method described—is shown for 20- and 22-gauge stainless steel in Table III. to be between $60,000 and $80,000 annually.

(3) The improvement in construction through the use of the sheet expansion micrometer increases the service life of all types of pasteurisers, regardless of the thickness of the steel used, from several years, or less, to an indefinite period.

Further, the use of the thinner gauge sheets of stainless steel makes it possible to use a lower temperature in the heating medium in the jacket of the pasteuriser because the thinner sheets conduct the heat three times as fast as the 14-gauge stainless steel. Hence, this feature actually improves the product of reducing the tendency to coagulate milk solids on the inner surface of the pasteuriser, and therefore improves the flavour of the product through the prevention of a cooked taste produced by the necessity of a higher temperature of the heating medium in the case of the pasteuriser constructed of 14-gauge stainless steel.

TABLE I

THICKNESS AND COST OF STAINLESS STEEL SHEETS
ALLEGANY METAL 18-8

		Price per Sq. Ft.
Thickness	*B.W.G. No. 22* = 0·028 =	$0·44
,,	,, *No. 20* = 0·042 =	$0·505
,,	,, *No. 18* = 0·049 =	$0·604
,,	,, *No. 16* = 0·065 =	$0·922
,,	,, *No. 14* = 0·083 =	$1·175

TABLE II

Number of pasteurisers fabricated in 1937 U.S., 3,111.
Average capacity, 105 gallons.
Approximate surface area, 35 square feet.

	Total Cost per Pasteuriser (Inside Vat).
Cost of metal (Allegany metal) No. 22 B.W.G. =	$15·40
,, ,, ,, ,, ,, *No. 20 B.W.G.* =	$20·80
,, ,, ,, ,, ,, *No. 18 B.W.G.* =	$24·30
,, ,, ,, ,, ,, *No. 16 B.W.G.* =	$32·25
,, ,, ,, ,, ,, *No. 14 B.W.G.* =	$41·10

TABLE III

SAVINGS POSSIBLE THROUGH USE OF LIGHTER GAUGE STEEL THAN 14 B.W.G. PER PASTEURISER

	Annual Saving to Industry.
Using No. 16 B.W.G. = $8·05 =	$27,850·00
,, *No. 18 B.W.G.* = $10·80 =	$52,220·00
,, *No. 20 B.W.G.* = $20·30 =	$63,200·00
,, *No. 22 B.W.G.* = $25·70 =	$80,000·00

TABLE IV

HEAT TRANSFER PER DEGREE CENTIGRADE PER SQUARE CENTIMETRE PER SECOND

No. 14 B.W.G. = 0·327	*gram calories*
No. 16 B.W.G. = 0·418	,, ,,
No. 18 B.W.G. = 0·554	,, ,,
No. 20 B.W.G. = 0·650	,, ,,
No. 22 B.W.G. = 0·970	,, ,,

The thermal conductivity of Allegany metal is 48 per cent. that of iron.

No. 22 B.W.G. Allegany metal will transfer three times as much heat per second as No. 14 B.W.G.

Saving in fuel, improved cream line.

Metal Containers for Food Products

THE confusion resulting from the multiplicity of sizes of cans used for packing food led to the appointment in 1936 by the Chemical Engineering Industry Committee of a representative Committee under the chairmanship of Sir Edgar Jones, K.B.E., to consider the preparation of British standards for the sizes of metal containers for food products.

The schedule provides for a standard series of can sizes for jams, fruits, vegetables, soups, fish, milk, and meat and meat products. It is confined to open-top and stud-hole cylindrical cans and to rectangular and oval "drawn" cans used in the fish-canning industry.

The Committee hope that the issue of a recommended British standard series of can sizes for each particular section of the canning industry will go far towards clarifying the position. Such national co-ordination is bound to be of material assistance to consumers, distributors, canners and canmakers, both from the standpoint of effecting a reduction in the cost of canning and by eliminating a very considerable number of cans of varying capacity and alternative heights and of removing the present uncertainty as to can capacity. The existing variation in can sizes tends to encourage undesirable practices, inasmuch as it enables odd sizes and packs, which are apparently identical with the standard packs, to be offered for sale at prices which appear to offer some advantage to the public.

The present issue of the British standard series had been confined to the cans for home and export trade used by British packers in the United Kingdom. The question has been taken up actively by the standards bodies in the other parts of the British Commonwealth, and it is hoped shortly to arrange an Imperial Conference, with a view to the unification of can sizes throughout the British Commonwealth of Nations.

Copies of this new British standard (No. 806, 1939) can be had from the British Standards Institution, 28, Victoria Street, London, S.W. 1, price 2s. each (2s. 2d. post free).

CONTROL OF MILK SUPPLIES

It is necessary to subject milk to a number of specific tests in order to ascertain whether the hygienic quality of any particular supply is satisfactory for the purpose for which it is required. These tests, their interpretation and limitations, are here described by

J. W. EGDELL

THE VALUE of laboratory testing of milk supplies is now fairly well recognised and appreciated by the dairy industry. Even in the more modest dairy and milk factory some attempt, though perhaps meagre, is made towards the scientific grading of producers' milk supplies.

Nobody can deny that during the last decade the hygienic quality of the nation's milk supply has undergone immense improvement. Simultaneously, however, the consumer has demanded a product of higher nutritive value and wholesomeness, consequently a properly equipped laboratory is to be regarded as an essential in every dairy and milk factory.

Hygienic Quality

The term "hygienic quality" as applied to milk is difficult to define shortly because it covers several aspects, all of some degree of importance, but having in many cases no direct relationship to each other. It is necessary, therefore, to subject milk to a number of specific tests in order to ascertain whether the hygienic quality of any particular supply is satisfactory for the purpose for which it is required.

For general purposes, especially when the milk is to be sold raw, the methylene blue reductase test is invaluable in that the bacterial activity which is taking place can be assessed in a comparatively short time. The determination of the acidity of the milk on arrival at the dairy is also helpful inasmuch as some idea of the degree of acquired acidity due to the growth and activity of lactic acid bacteria can be obtained. In addition, the alcohol test and the sediment test by the centrifugalisation method, both comparatively rapid in execution, serve to expose other inferior supplies.

Taints of a non-bacterial nature are invariably present when milk reaches the dairy, and affected supplies can best be detected by sense of smell while the milk is still in the churn. It is most essential that the person delegated to this work should have a keen sense of smell and thus be able to detect the slightest off-flavour, because it requires the inclusion of only a relatively small quantity of such tainted milk in the bulk milk of the dairy to render the whole unsaleable or unsuitable for manufacture.

More Technical Tests

In the larger type of dairy or milk factory the above-mentioned control, valuable though it may be, is totally inadequate to meet all requirements. More technical bacteriological tests are called for, and these include the direct microscopical examination, estimation of the number of bacteria by the plate count method, the presumptive coliform organisms test, fermentation and keeping quality tests. Direct microscopical examination of a suitably stained film of milk provides a picture by which the type of bacteria and cellular elements can be studied. This is essentially a qualitative test, although, after considerable experience, it is possible to utilise it as a rough guide in a quantitative capacity.

The plate count test is useful not only for the enumeration of bacteria in milk which is to be manufactured, or marketed in the raw state, but more particularly for determining the number of thermophilic and thermoduric organisms in milk which is to be pasteurised.

The presumptive coliform test, in spite of some criticism as to its value, in the opinion of the writer still serves an extremely useful purpose when the part played by these organisms in the deterioration of milk and dairy products is fully appreciated.

In cheese factories the fermentation test, usually conducted in conjunction with the methylene blue test, gives an indication of the type of curd to be expected from producers' supplies. For this purpose, however, it is probably not quite so reliable as the Wisconsin curd test, which is the same in principle but is expressly designed to reproduce cheese vat conditions. Strictly speaking, in the liquid milk trade all micro-organisms are definitely undesirable, but in the manufacture of cheese there are exceptions. For example, milk which can readily be condemned under the methylene blue, acidity, and plate count tests on account of the large number and the activity of the bacteria may produce a perfectly good curd free from off-flavours. Alternatively, a milk supply with a relatively low bacterial count, satisfactory reduction time, and normal acidity may give a gassy, soft, or slimy curd with an undesirable odour and flavour; it is for the detection of such milk that a fermentation test is necessary.

The keeping quality test, while theoretically sound, depends to a large extent upon the personal factor and consequently is not always reliable in actual practice. As a comparative test, however, it is valuable for estimating the "useful life" of individual producers' supplies.

Interpretation of Results

Bacteriological results may be meaningless and frequently misleading unless the limitations of the tests are

borne in mind and the findings interpreted with extreme care. The methylene blue reduction time of milk is very largely dependent on the temperature to which it has been exposed and the age of the supply at the time of testing. Carelessly produced milk exposed to a temperature not exceeding 45° F. and examined within 3 or 4 hours after production will satisfy a high reduction time standard, whereas reasonably clean milk held at an atmospheric temperature in the region of 70° F. for almost a day may fail to satisfy a 4-hours' standard. It is suggested, therefore, that for ordinary market milk examined when approximately 18 hours old, a reasonable reduction time standard to aim at in attempting to grade up dairy supplies would be 3 to 4½ hours during the summer months and 4½ to 6½ hours as the atmospheric temperature becomes increasingly colder; these suggested standards would, of course, be correspondingly higher for morning milk tested within 3 to 4 hours of production.

Plate Count Test

The plate count test is likewise dependent on temperature and age factors, but with the difference that, even though a carelessly produced milk has been held at a low temperature, the bacterial count, due to the initial contamination, will be relatively high. Where due care has been exercised during production the bacterial count will very rarely exceed 50,000 per ml. of milk; normally, of course, the count is very much less. In summer time, on the other hand, the standard must be lowered to 250,000 to 300,000 per 1 ml. to allow for the effect of temperature.

Presumptive Coliform Test

In spite of certain criticisms, it is maintained that the presumptive coliform test is a good measure of the degree of care taken during production. It is admitted, however, that the value of the test may be reduced where the milk has been exposed to an abnormally high atmospheric temperature, when coliform organisms are capable of rapid reproduction. Nevertheless, it is the writer's opinion that only some types of coliform organisms are capable of reproduction below 60° F., and, more important still, multiplication of these types is comparatively slow at first. Furthermore, it is only when the temperature exceeds 70° F. that the multiplication of coliform types in general is such as to affect seriously the result of the test, and the interpretation in the light of farm conditions. Thus it is not considered unreasonable to expect coliform organisms to be absent from 1/100 ml. of milk when the age at the time of testing does not exceed 18 to 20 hours.

Apart from the fermentation test, the coliform test is probably of more value than any other for grading cheese milk, in which the presence of large numbers of gas-producing organisms is most objectionable. Not infrequently it happens that when steam sterilisation of utensils is conscientiously applied on the farm, but the actual cowshed-production methods are sadly at fault, the bacterial count and reduction time of the milk are satisfactory, yet coliform organisms may be present in 1/1,000 or even 1/10,000 ml. of milk; the utilisation of such milk for cheese-making will invariably result in the production of a very gassy curd with the characteristic off-flavour.

Cell Content

A large sediment or cell content in itself is of no real significance, but if the cells, when examined microscopically, are found to be polymorphonuclear and they are accompanied by long-chained streptococci, the normal conclusion to be drawn is that mastitis infection exists in the producer's herd; even so, it is always wise to confirm such findings by further specific cultural tests.

The results of the acidity test, alcohol test and fermentation test are usually clear-cut and need no special mention here.

In conclusion, it must be emphasised that the only really successful way to keep an efficient control over incoming supplies of milk is by frequent and regular sampling and testing. By so doing, the general quality of each producer's supply over a long period is ascertained, and the data will be extremely useful to the farms inspector in advising producers how to correct any defect and improve their supplies generally if necessary.

Judging Quality in Dairy Products

(*Continued from page* 357)

as it was before," but only the experienced cheese-maker can effectively apply the text to his curd. Perhaps we shall find that the greater part of the skill of the expert lies in just this capacity, and if that be so the instruments of the future may be able to measure the physical properties which he needs to know perhaps with far greater accuracy than can be done by hand, but the expert will still control the processes at will, and dairying will have become a science without having ceased to be an art.

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Shortening: from a Baker's Point of View

A SHORTENING should have the following characteristics:

Long plastic range which will ensure proper distribution even at low temperatures. Lard has the longest plastic range, but becomes rather soft at high temperatures. Vegetable oil compound type shortenings have a firmer body and therefore are preferable if the product is to be stored at temperatures of 90° to 120° F. Hydrogenated shortenings become very brittle at temperatures near freezing, though the manufacturers of this type often vary the plasticity according to the season so that it may be neither too soft nor too hard. Butter has a good plastic range, but coconut oil margarines are rather poor in this respect.

For products which require a high percentage of shortening, a pleasant flavour is an important characteristic in the latter. Vegetable shortenings are considered to lack flavour.

Shortening Power

High shortening power is an important factor. An approximate listing of fats and oils according to their shortening power is as follows:

Lard.
Hydrogenated shortening.
Compound shortening.
Cottonseed oil.
Butter.
Coconut oil.
Edible mineral oil.

Good keeping quality at room temperature, freedom from foreign odours, and the effect of the shortening on the colour of the baked product are also of importance.

Effects of Shortening

The primary effect of shortening in bread is a lubricating one. It enables the individual gluten strands and particles to slide over one another more easily, with the result that:

1. The fermentation period is reduced by approximately 3 per cent.
2. The crust is more tender.
3. The volume of the loaf is improved to amounts approximating to 3 per cent.
4. The symmetry of form and the grain of the bread are improved.
5. The texture becomes finer and more silky.
6. The development of crumbliness is delayed.
7. The life of the bread is increased, probably due to the coating of shortening around the individual particles, delaying the loss of moisture.

Other Effects

There are other effects which are due simply to the presence of the shortening—viz.:

1. The crust has more lustre.
2. The crumb colour is more brilliant.
3. The energy value of the bread is increased, since fats or oils yield 2¼ times as much energy as carbohydrates.
4. The flavour and taste are improved.

According to recent X-ray studies, as bread, or other yeast-raised products, leave the oven the starch has both a crystalline and an amorphous component. As the product ages the amorphous component disappears, and finally all the starch exists in a crystalline form. This change takes approximately 24 hours and is responsible for the development of staleness. So far there is no direct evidence that shortening delays this ageing of the starch granules, though observation clearly indicates that it prolongs the life of the baked product.

From a paper read by W. H. Cathcart before the American Oil Chemists Society.

Book Review

Standard Solutions

The Standardisation of Volumetric Solutions, *R. B. Bradstreet. 120 pp. New York and London. 15s. net. (Cloth bound; mimeo-lithographed.)*

This is a handy reference book of convenient size. It contains little theory, but deals in straightforward fashion with methods of preparing common analytical solutions, special attention being given to standardisation. There are short sections on calibration of apparatus and some corrections in weighing. References are supplied for further reading on points noted. There are tables of equivalents, logarithms, the density of water at numerous temperatures, equations, and other information of the sort that is often wanted but is difficult to find when wanted. There is no doubt about the utility of the book; the only question is whether it is worth the price asked. The reviewer thinks that, once the book were bought, it would be frequently consulted.

H. N

Correspondence

The Editor.

DEAR SIR,

In FOOD MANUFACTURE, August, 1939, page 282, we read an article about foods at the Swiss Exhibition. Under this heading you wrote:

> "Conserved cucumbers are being displayed in the pavilion by the Conservenfabrik Company, of Bischofszell."

We wish to inform you that there must be some misunderstanding, and would draw your attention to the three following points:

1. All Swiss canning factories which belong to the Association of Swiss canning factories are displaying their products in the same pavilion.
2. The Swiss National Exhibition is the first showing the manufacturing of preserved foods.
3. At this Exhibition only conserved fruits are manufactured; no vegetables, meat, or other preserved foods.

We are, dear sir,

Yours faithfully,

CANNING FACTORY, BISCHOFSZELL
(FOBLER AND CO., LTD.).

PLANT AND EQUIPMENT

BAKERY

Bakery Equipment

A complete and illustrated catalogue of 180 pages dealing with practically every known utensil for the bakery, confectionery and catering trades has been issued by T. Errington and Sons, Ltd. A glance at the index will give an idea of the number of articles they manufacture. The catalogue is divided into coloured sections for easy reference, and comprises Bakery Utensils, Woodwork, Machinery and Ovens, Kitchen Equipment, Catering and Ice-Cream, Shop and Window Fittings and Chocolate and Confectionery. Each illustration is accompanied by a short description, where necessary, and a statement of the sizes in which the particular article may be obtained. The catalogue itself is bound in a strong cardboard cover with gold facings.

WATER SUPPLY

Underground Water Supply

The modern creamery or milk factory requires an enormous amount of water for serving the various items of the plant used in these factories such as refrigerators, milk coolers, bottle washers, steam raisers for sterilising, washing down, and other purposes.

Sometimes this need can be met by the water from the nearest public supply authority, but this often proves a very expensive method. Fortunately, however, in most parts of England a supply of water is available below ground, and it is only necessary to bring it to the surface by means of a borehole pump to avoid this expense, the cost of running such a pump being negligible when compared with the cost of purchasing the water in bulk.

A good example of this type of borehole pump has been installed by the Pulsometer Engineering Company, Ltd., of Reading and London, at a factory belonging to the Milk Marketing Board.

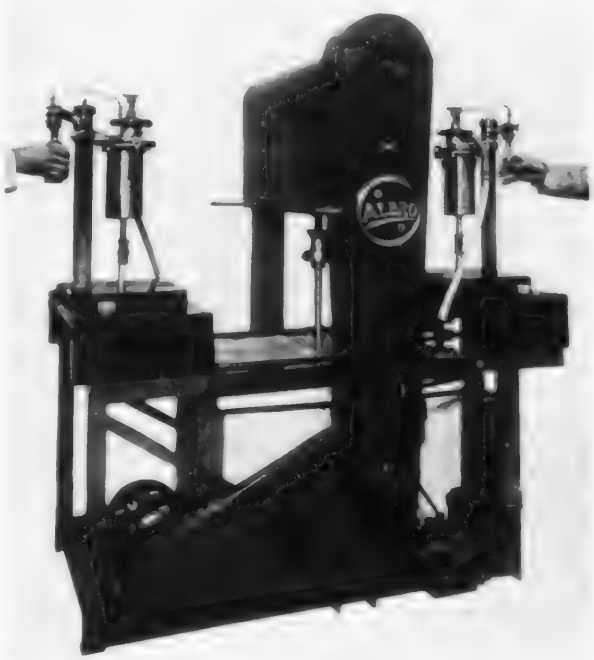
The pump is situated 120 ft. below ground level in a 9½-in. diameter borehole, and is capable of raising eight thousand gallons of water per hour from this depth, forcing it through the water softener, and ultimately delivering it to a tank 44 ft. above ground level. It is from this tank that the factory draws its whole water supply, and a float in this tank actuates a switch which starts and stops the pump according to the actual demand.

The pump consists of thirteen stages, and is supported from the ground level by a 5-in. steel tube. Down the centre of this tube, which is also the delivery main, runs the driving shaft from the electric motor at the surface. At intervals of 6 ft. 6 in. through the entire length of the tube cast iron spiders are fitted carrying lignum vitae bearings which are lubricated by the water being pumped, the shafting being fitted with a bronze sleeve at every point where it passes through a bearing.

Although the yield of the borehole was tested as usual when it was originally sunk and found to be ample, a depth indicator is fitted to the pump, from which the depth of water in the borehole can be seen at a glance.

FILLERS

Powder Filling Machine



An "Albro" double head semi-automatic powder filling machine which is completely dustless in operation and works on the vacuum principle. It is very suitable for filling peppers, spices, milk powders, custard powders—in fact any powder product—into rigid containers such as cardboard drums, tins or bottles. The hopper can be fed by gravity from the floor above, or can be supplied with a vacuum pick-up attachment for drawing the powder from a receptacle on the floor level.

PLANT AND EQUIPMENT

BOILERHOUSE CONTROL

Automatic Boiler Control

The Government Instructions outlining the precautionary measures necessary in the event of attacks by hostile aircraft, give much useful information concerning the safety measures to be adopted for workpeople, etc. The Power Plant executive, however, is faced with the problem of continuing production irrespective of the possibility of delays and stoppages due to air raids or raid warnings.

One of the vital necessities is the proper control of the supply of steam, whether in generating stations serving domestic or industrial load, or in boilerhouses in works on essential production for National Service. There are means available whereby all necessary safety measures can be put into operation, continuation of supply assured, and this at a cost which is quickly recoverable by more efficient operation. Further, this increase in efficiency of operation means a reduction in coal consumption, a factor of considerable importance at this time.

Changing load conditions would have to be met quickly and effectively. The load would be drastically reduced upon receiving a warning, and the boiler plant operated at this low level until conditions were safe to resume production again. Upon resumption, load would be increased as quickly as possible. These alternating conditions may occur several times in the course of a few hours. During these times it is necessary to accommodate the operating staff in a place of safety. The problem confronting the executive is therefore apparently formidable, in that it is just these rapidly changing conditions which reduce the efficiency of boiler plant operation, and harass the operating staff. These conditions, however, have been met, and with complete success, by the use of "Kent" automatic boiler control, made by George Kent, Ltd., of Luton.

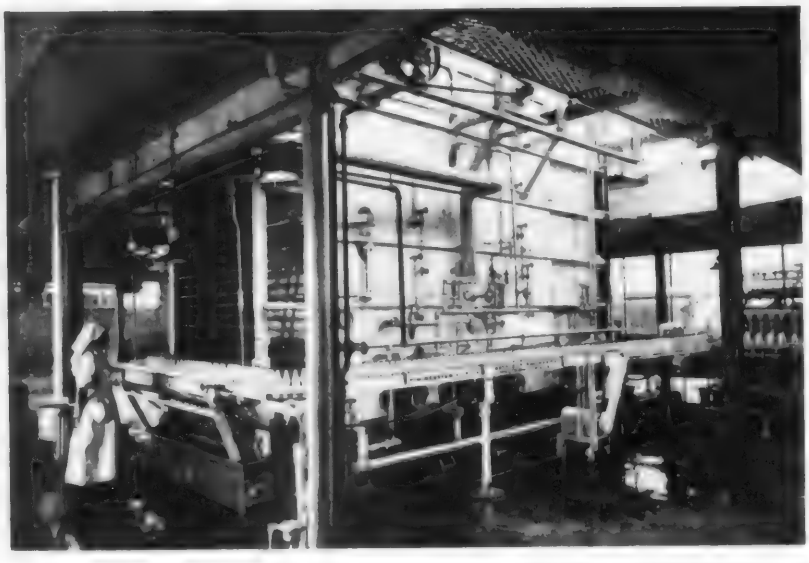
A system of automatic boiler control, in which the draught, air and fuel supply are separately controlled, is a necessity under emergency conditions. Load variations, however sudden and violent, can be met with comparative ease, without any aid from the operating staff. This is an actual everyday condition where "Kent" automatic control equipment is installed in industrial boiler plants with rapidly fluctuating load conditions. Coal and air are automatically proportioned, correctly, at every point of the load curve. This means considerable saving in fuel, and the complete absence of "blowing off" steam from the safety valves. The latter feature is an important factor, as if prolonged "blowing off" occurs, it is a distinct attraction to hostile aircraft. Under normal hand control conditions it is practically impossible to prevent this when load is drastically reduced.

The master controller, which acts as a "governor" on the whole boiler plant under control, definitely controls the steam pressure irrespective of load variation, and keeps it within very close limits. This master controller, which is virtually the heart of the system, can be located in a safe position, where with the absolute minimum of risk one man can observe and control the boiler plant.

Remote control can be provided at this point so that the operator can over-ride the automatic control if in his experience it should be necessary at any time.

This system of automatic boiler control can be applied to any type of boiler plant, small, medium or large.

MILK STERILISING EQUIPMENT



A part of recent installation of one of two complete plants for the production of sterilised milk at the dairy of the Cheshire Sterilised Milk Co., Ltd. Each plant has a capacity of 6,000 pint bottles per hour, and was manufactured and installed by R. W. Webster and Co., Ltd., Waltham Cross, Herts.

The illustration shows the "Pioneer" Automatic Steriliser, the feed of which is also on the upper floor, where the bottling is carried out under ideal conditions. The bottles, seen discharging, pass to an automatic labeller, where they are fed into washed cases ready for despatch.

PLANT AND EQUIPMENT

ELECTRICAL CONTROL

Power Control for Hotplates

A disadvantage which seriously hinders the general adoption of electric cookers is that the hotplate, or boiling ring heat is not continuously variable, but is generally limited to "three heats" only. Sunvic Controls, Ltd., claim to have overcome this difficulty with their Simmerstat Control, which allows the hotplate input to be continuously adjusted from no load to full load by simply turning a knob, which takes the place of the normal three-heat switch on the cooker switch panel.

The control operates by opening and closing the electric circuit to the hotplate for short definite time intervals. Clearly the longer the *off* time and the shorter the *on* time, the smaller will be the average input to the hotplate and the lower its temperature. The net effect is the same as that of introducing series resistance, but involves no waste of power.

Since the Simmerstat Control merely alters the average input on a time basis, no tappings are required on the hotplate, which need only have a single circuit arranged for the full loading. The need for a three-heat switch is eliminated.

INSTRUMENTS

Dew-Point Control

In many installations of industrial and commercial processes it is essential to maintain both temperature and humidity at pre-determined levels, or at least to maintain some definite relationship between the dry-bulb temperature and the relative humidity.

Dry-bulb temperature in the conditioned space may be controlled by a room thermostat, which governs the operation of a motorised valve included in the steam or hot-water line to the re-heater or booster.

Dew-point control is achieved by governing the temperature of the saturated air leaving the washer. Several methods are available, the choice depending upon the inside conditions required and the outside conditions likely to obtain. Each method is capable of being applied in a large number of ways, but all can be satisfactorily controlled, it is claimed, by one or more of the wide range of standard "Teddington" Instruments, manufactured by The British Thermostat Co., Ltd.

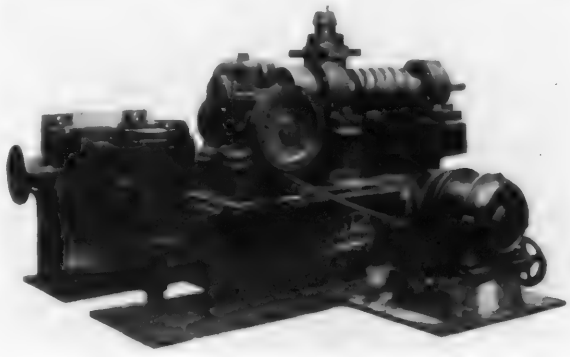
DRYERS

Tray Dryer

New improved tray dryer, now built of entirely welded construction, and insulated with asbestos. Heating is by steam, and the air-circulating fans are now built with special bearings to withstand the temperature. The special features of this new type oven are the uniformity and rapidity of drying of all materials suitable for handling on trays. The trays for this oven were made of polished stainless steel and were introduced into the oven on conveyor trucks of all welded construction.

Made by Apex Construction, Limited, of London, W. 1.

POWER TRANSMISSION



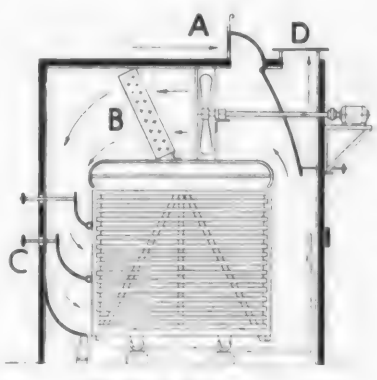
Two-Shaft Variable Speed Drive

The photograph illustrates a special dual shaft infinitely variable speed drive made by Crofts (Engineers), Ltd., of Bradford. Both output shafts drive in a vertical position, the main drive being bolted to the driven mechanism through the vertical flange shown. This flange forms part of a hollow spindle, inside of which revolves the secondary vertical shaft having bevel pinion keyed thereto for driving the auxiliary mechanism.

Both main and auxiliary drives are infinitely variable and are driven through variable speed pulleys, the main drive is reduced in speed from 1,450 to any speed between 3 and 6 r.p.m. The horse power transmitted is 1 h.p. at top speed against constant torque.

The auxiliary drive has the motor mounted in a vertical position and drives direct on to the output shaft through V rope. The speeds for this auxiliary drive range from 960 to any speed between 65 and 195 r.p.m. The horse power transmitted is 3 h.p.

The complete drive, mounted on a fabricated baseplate, is entirely self-contained and adequately guarded to comply with Factory Act Regulations.



Uniflow Dryer.

A.
Fresh air supply.

B.
Finned Heating Elements.

C.
Adjustable vanes to distribute the air stream.

D.
Adjustable discharges.

PLANT AND EQUIPMENT

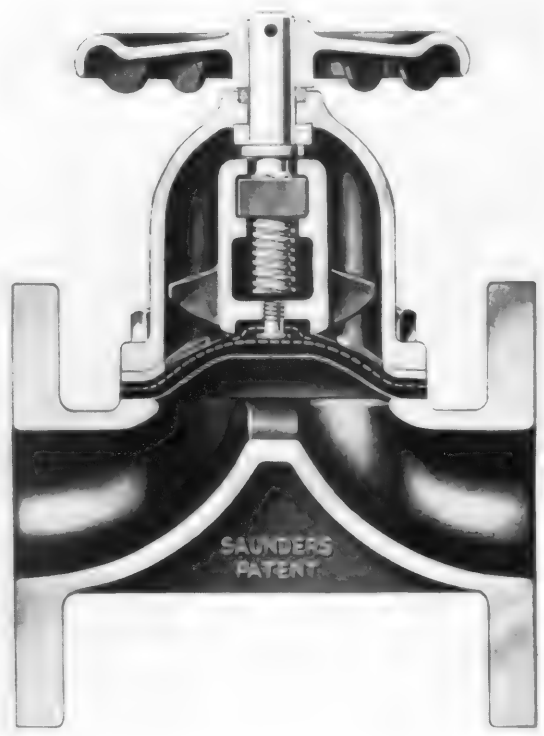
VALVES

A Simple Valve

The basic principle of the valve manufactured by the Saunders Valve Co., Ltd., is the replacement of metal-to-metal closing contacts by the flexing of a reinforced rubber diaphragm. The flow is arrested at a given point by the descent of this highly resilient and durable closure member on to a weir in the body of the valve to provide a perfect seal. Conversely, to release the fluid the closure member is withdrawn by regulated action until it coincides with the normal surface of the pipeline to form a streamline passage.

This elementary simplicity of design offers the outstanding advantage of separating the working parts of the valve from the fluid. By replacing the usual troublesome gland with a resilient diaphragm no leakage can occur; ease of operation is obtained owing to undisturbed lubrication; sensitive liquids such as emulsions or foodstuffs are not contaminated; there are no pockets to collect solids and prevent perfect closure—in fact, the rubber diaphragm closes over any small solids trapped. The design has the further advantage that the valve can be made of commercial materials, and the body can be provided with glass, rubber or lead linings to resist the action of chemicals and abrasives. Absence of accurate metal faces means that the inconvenience of seizing and jamming cannot occur, and maintenance costs are reduced to occasional replacements of the rubber diaphragm. These replacements can be easily carried out without removing the valve from the pipeline.

The merits of the diaphragm principle have been so widely recognised that these valves are now employed in practically all classes of industry for handling compressed air and water, and all "difficult" fluids such as gases, chemicals, sludges, pulps and fluids containing solids in suspension.



The Saunders Valve.

ALLOYS AND METALS

Use of Alloys Saves 25 Per Cent. Tare Weight

A new insulated van incorporating many interesting features has been built by Messrs. S. T. Abbotts, Ltd., of Walsall, for the Midland Counties Dairies. This van is designed to carry two tons of ice-cream which is loaded at night, the vehicle previously having been refrigerated to a temperature of −14° C. During a normal 12-hour working day with a maximum of 60 openings of the doors, the temperature will not rise 5° above zero although the refrigeration is not continuous.

The efficiency of insulation in the body is remarkable. The insulating medium between the "Noral" aluminium alloy skins is "Onazote" expanded rubber, 5 in. thick at the sides and roof and 6 in. in the floor, weighing in all 7¼ cwt.; the "Utectic" pads, together with the pipe lines, valves, etc., weigh 13 cwt., while there are 3 cwt. of "Durastic" sealing compound and paint.

There is no metal-to-metal contact between the inner and outer skins, which are of NA3S½H aluminium alloy sheet, and, in addition to the insulation, the body has a cavity roof in which revolving air extractors create a partial vacuum while the vehicle is in motion.

The aluminium alloys used comprise NA.3S½H and NA.4S½H sheet and HA.13SQA sections, the cab being a composite structure of wood and alloy sheet. It is estimated that if timber had been used throughout in the construction of this vehicle in the place of aluminium alloys, the tare weight would have been 12-15 cwt. greater, so that a saving of over 25 per cent. has been achieved. The aluminium sheet is also an excellent medium for heat-insulation by virtue of its high reflectivity and low radiation.

The body has been designed so that it can easily be transferred to another similar chassis.

The above details were kindly communicated by the Northern Aluminium Company, Limited.

Nickel

Various items of news and interest on nickel and its alloys have been abstracted from journals, reports, papers read at scientific meetings and elsewhere by the Mond Nickel Co., Ltd., and published in the form of the Nickel Bulletin. In order to be of service to metallurgists, these abstracts have been grouped together under headings of Electrodeposition, Non-Ferrous Alloys, Constructional Steels, and so on. A list of patents in connection with nickel has also been included.

PLANT AND EQUIPMENT

GAS PRODUCER PLANT

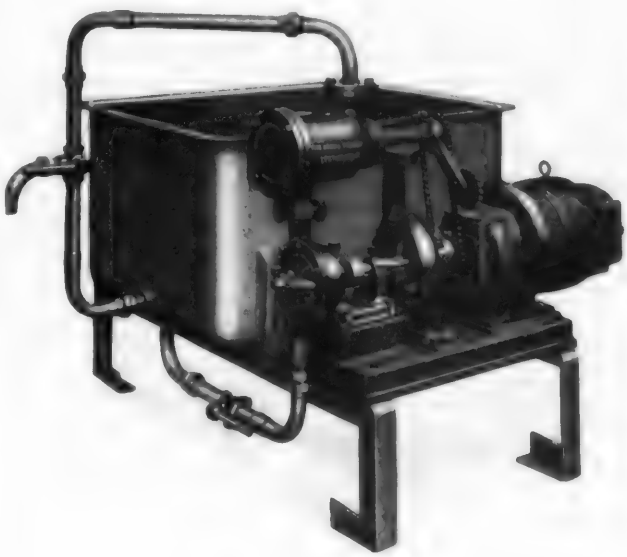
The "Koela" Gas Producer

With the increasing importance of effective operation of road transport services in the present conditions, consideration has been given to alternative means of operating internal combustion engines. The Brush Electrical Engineering Co., Ltd., have taken over the patents, manufacture and sale of the "Koela" gas producer, which can be applied for the driving of all types of internal combustion engines, and which has been specially developed for the use of all classes of motor vehicles.

MINCING AND MIXING

Safety Silent Mincer

The amount of noise and the number of accidents resulting from one machine is a point which has been taken into consideration by Macnaughton and Watson, Glasgow, when making the new "Scot" Safety Mincer and Mixer. The operator is safeguarded by a special electric safety device, and an arrangement has been made whereby the knife-shaft cannot revolve when the cover is open. Another advantage is that the contents of the machine can be watched while it is in operation, and the manufacturers claim that sausage meat minced in this machine keeps in condition days longer than meat minced in any other machine.



Egg Texturating Unit.

DAIRY EQUIPMENT

Glass-Lined Dairy Equipment

Milk and milk products must obviously be produced and distributed under scrupulously clean conditions. One answer to this problem is the glass-lined equipment manufactured by Enamelled Metal Products Corporation (1933), Ltd., London, S.W. 1. Besides glass-lined plant such as mixers and emulsifiers, they also manufacture glass-lined storage and transport tanks. The lining of the tanks presents a smooth surface of glass, which has been fused into a sturdy all-welded steel body, and which is a very simple matter to keep clean. The product to be processed or distributed thus remains quite fresh and is never subject to flavour contamination either by metals or unsanitary conditions. Particularly in regard to transport tanks, such lining helps to maintain a low temperature and low acidity better than any other material. All "Pfaudler" glass-lined equipment has been proved to be thoroughly durable and will last for years without becoming any less sanitary.

EGG TEXTURATING

Treatment of Frozen Eggs

The Egg Texturating Plant is designed to handle defrosted frozen whole egg. Considerable care is necessary in de-frosting in order to avoid deterioration, and defrosting should be carried out with cold water. Before placing in the de-frosting tank, the lids of the tins should be cut off and laid on loosely. From time to time the lids are lifted and the eggs tested with a glass rod. As soon as the tins are ready, they are tipped into the receiving tank of the Texturating Unit, as illustrated. In the top of the receiving tank is a strainer which arrests large particles of frozen egg. The egg passing to the tank is in a cold fluid state, although there will abound a quantity of ice crystals. Once a workable quantity has been passed to the tank, supplies for the bakery may be drawn. There is a pump direct-coupled with an electric motor, and above this the texturating machine, which is constructed in "Ni-resist" cast-iron. It has two moving sleeves, and anything passing through is completely broken down to a perfectly smooth and cream-like consistency. The feed of the machine is only 40 r.p.m., and as the whole of the system is enclosed there is absolutely no aeration of the egg product. One passage of the material through the machine is sufficient to obtain a perfectly blended egg, devoid of particles and as smooth as silk. The machine is a patented speciality of William Douglas and Sons, Ltd., of London, S.W.15.

In drawing off supplies for the bakery, the motor is started up. The filling tap is a three-way one; it is set so that the delivery will return to the tank. This gives a little mixing in the tank, which is supplemented by the use of a hand plunger. Without delay, containers are brought under the filling tap and supplies are drawn off.

NEWS FROM THE INDUSTRY

North-East Development Board

The third edition of the folder issued by the North-East Development Board, which covers the counties of Northumberland, Durham and North Yorkshire, comprises a list of the products manufactured within the area.

Among those of interest to the food industry are Fish and Fish Products, Baking Powder, Biscuits, Canned Foods, Cooked Foods, Flour, Ice-Cream Wafers, Jam and Preserves, Pickles and Sauce, Sweets and Toffee, Glass Bottles, Laboratory Fittings and Tin Containers.

* * *

Colonial Products

The drive which is being undertaken to make Britain's Colonies and their immensely varied products better known is shown in the report by the Colonial Empire Marketing Board. This organisation was set up, it may be remembered, by Lord Harlech, Secretary of State for the Colonies, in 1937, to help "Colonial territories to develop their own sources of wealth, to sell more goods and to sell those goods to better advantage".

The Board began operations in March, 1938, and its work during the first year can be divided into two main sections: first, to put into the mind of the general public at home a far clearer picture of Britain's possessions overseas; and next, to investigate—and to improve the ways in which leading Colonial products are brought to market.

It is clear that producers and traders in the Dependencies will have to reorganise the growing and selling of a number of commodities before an unvarying high standard of quality can be guaranteed. Until that day approaches, the Board wisely believes that to "push" these Colonial products would do not good but harm. But, in the meantime, it is seeking to create an interest in the Colonial Empire and its resources, which will presently stand exporters in good stead.

The Board has commissioned a short book which compresses the history and development of the Colonies into a lively, absorbing story—the sort of book which people will read widely. The aid of the films is also being vigorously enlisted. A picture showing how the Colonies are administered and their populations cared for is in production, and this general film will be followed by a series of snapshots of life and industry in individual Colonies.

The Glasgow Exhibition and the New York World Fair have provided other opportunities which the Board has seized to bring Britain's distant possessions before millions of eyes. Plans are being made to ensure that at similar future exhibitions the Colonies and their resources shall be even more attractively presented.

* * *

A.R.P. Training

Factory owners who are worrying about compliance with the National Defence Act will envy their confrères on the Team Valley Trading Estate, who, thanks to the help of the Estate Company, can participate in a group training scheme. A series of seven weeks' courses in anti-gas action and fire-fighting are being held for employees of all factories to whom the Act applies. Three hundred and fourteen people are taking part in the first series, for which the Chief Constable of Gateshead is supplying instructors and equipment.

Courses in First Aid have been arranged in co-operation with the National Service Committee, instructors being provided by the British Red Cross and St. John Ambulance Brigade.

A comprehensive scheme of air-raid shelters is now being worked out for this Estate, where there are 101 factories in production, employing some 4,000 people.

* * *

Grass since Napoleon's Day

The first furrows were turned in Bushey Park on October 17, part of the contribution of the Royal Parks to Britain's "plough-up" campaign. The land being ploughed is in the part known as "The Wilderness", and the records show that it has not been ploughed for at least a hundred years although the marks of very old furrows can still be traced. Probably the last time it grew corn was in Napoleon's day, when Britain at another time in her history had to use her resources to the full.

The newly turned furrows promise a rich, dark tilth, with a gravelly sub-soil that will make for good drainage.

Mr. W. J. Hepburn, Park Superintendent at Bushey, said that most of the land would probably be sown with oats, although he hoped to grow some wheat as well if weather conditions were favourable.

Weighing of Cattle

Certain functions relating to the weighing of cattle and weighing facilities at livestock markets, which had been exercised by the Minister of Agriculture and Fisheries, were in January last delegated to the Livestock Commission under Section 21 of the Livestock Industry Act, 1937.

Having regard to the contemplated suspension in the near future of all the functions of the Livestock Commission in accordance with the Defence (Agriculture and Fisheries) Regulations, 1939, the Minister has made an order under which he now resumes those functions which had been delegated to the Commission.

* * *

OBITUARY

SIR WILLIAM POPE

A Great Chemist Passes

Sir William Jackson Pope, Professor of Chemistry at Cambridge University, died at Cambridge on October 17. Pope will be remembered, among other achievements, for his services to the nation during the late war.

At that time, he became a member of Lord Fisher's Admiralty Inventions Board and was consulted by various Government Departments. The preparation of materials of war, hitherto not made in this country, had to be worked out and rapidly put into practice.

In connection with aerial photography Pope and his co-workers worked out the methods for the preparation of dyes used in connection with panchromatic plates, never before made in any country but Germany, who enjoyed a monopoly. Not only were the actual compounds made on a commercial scale in the space of a few months, but new and better ones produced.

Pope was educated at Finsbury Technical College, from whence he proceeded to the Central Technical College; in 1897 he became head of the Chemical Department of the Goldsmiths' Institute at New Cross, where he made his first important contribution to science.

Pope went to Manchester in 1901 as Professor of Chemistry at the Municipal School of Technology, and from 1905 to 1908 was Professor of Chemistry at the University of Manchester. In 1908 he became Professor of Chemistry at Cambridge. In 1914 he received the Davy medal of the Royal Society, having been elected Fellow in 1902.

INFORMATION AND ADVICE

Cod Liver Oil—Jelly Dices and *p*H Testing—Preserving Fruits and Green Vegetables—Chicken Canning—Insulation—Information Supplied

Cod Liver Oil

5,577. *We have read with great interest the article entitled "Dr. Cruess Sails for U.S.A." on page* 189 *of* FOOD MANUFACTURE *for June, 1939, and wonder if you could give us the name and address of manufacturers in Norway of the cod liver oil which tastes like olive oil.*

We shall greatly appreciate your good offices in this connection, being interested at the moment in the manufacture of a cod liver oil emulsion. (Durban.)

We are advised that owing to the unique production circumstances—*i.e.*, cold weather during fishing and a very short journey to land the catch—it is possible to produce Norwegian cod liver oil in a very fresh state, and as all producers do this it is very difficult to mention any one in particular. However, our informant gave the name of suppliers.

Jelly Dices and *p*H Testing

5,604. *In your June issue of* FOOD MANUFACTURE *you give two or three items which are of interest to us, and we would like your replies.*

For instance, in "Information Required, No. 5,273", particulars for making a jelly to cut into dice to put into a cake. Will you be good enough to let us have a reply? Also No. 5,264, information on pH testing. (Adelaide.)

Enquiry No. 5,273.—The publication of the enquiry has not evoked any useful information up to date, except one suggestion that agar agar might be used, the percentage of the substance being about 2 per cent. Personally, though it is not in our province to carry out experiments, we are of the opinion that this would not be a success, although you might possibly try it out. If you do, we suggest that you try even higher concentrations of agar agar.

Enquiry No. 5,264.—You will find this information in most modern textbooks of chemistry. The British Drug Houses, Ltd., issue a booklet on "*p*H Values, what they are and how to determine them", and would be pleased to send this to you free of charge.

Preserving Fruits and Green Vegetables

5,632. *We are interested in preserving fruits and green vegetables, first of all making them dry by means of some drying machine (not by sun rays) and then preserving them. We shall, therefore, be highly obliged if you would please let us know whether it is possible to dry up green vegetables and what those dried-up vegetables would be like, as regards their flavour, deliciousness and vitamins, etc. Lastly, tell us the addresses of those firms which manufacture such dryers and oblige.* (British India.)

It is, of course, quite possible to do this in such a way that most of the flavours and vitamins are retained.

The names of firms making drying plant were given.

Chicken Canning

5,648. *At the present moment we are very interested in the canning of chicken, and should be obliged if you could let us have any literature in this connection or any advice on the cooking and canning of chicken.*

We should like a good recipe for tinned chicken in whole 1½ lb. or 2 lb., chicken dead weight, or for breasts and dark meat. (London.)

A number of articles have been published in FOOD MANUFACTURE on this subject:

December, 1931, p. 354, T. Crosbie-Walsh.
February, 1932, p. 46, A. Samson.
April, 1932, p. 103 (Packing in Glass).
October, 1933, p. 325, T. Crosbie-Walsh.

The first two numbers are now out of print, but photostat copies can be obtained, price 4s. Copies are still available of the other two issues at a charge of 2s. 4d. each.

With regard to recipes for tinned chicken, the process is a highly technical one and we should suggest that you obtain the advice of an expert. We should be pleased to give you the name of one should you so desire.

Insulation

5,631. *As regular readers of your most valuable paper,* FOOD MANUFACTURE, *would you please advise us as regards insulation of a cold store?*

We are having 4-inch cork-slab insulation. Which makes the best job, one layer of 4-inch blocks or two layers of 2-inch blocks? We should appreciate your kindness if you could help us. (Chesterfield.)

There would not be very much difference between one layer of 4-inch blocks and two layers of 2-inch blocks, *provided* that sealing is very efficient. This is the main point.

Information Supplied

5,460. *Can you please inform me of firms who can supply rubber-tyred casters for bins, also number burners for trays?* (York.)

This information has been given.

5,408. *We shall be glad if you can kindly give us the name and address of the manufacturers of "Avenex", a preparation made in the U.S.A. from oat flour.* (Holland.)

The name of the manufacturers was given.

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RECENT PATENTS

These particulars of new patents of interest to readers have been selected from the "Official Journal of Patents", and are published by permission of the Controller of H.M. Stationery Office. The journal can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. weekly (annual subscription £2 10s.).

Abstracts of Recent Specifications

Group Abridgments can be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, either sheet by sheet as issued on payment of a subscription of 5s. per Group Volume, or in bound volumes price 2s. each.

Preserving food

The provisional specification describes the treatment of foodstuffs and other substances which develop rancidity or undergo similar decomposition by addition of protective substances derived by high-vacuum short-path distillation from natural oils.

507,471. Kodak, Ltd. (Eastman Kodak Co.).

Preserving eggs

Eggs in the shell are preserved by inserting in a container, the air in which is then replaced by a preserving gas substantially free from oxygen, the gas introduced being replaced at intervals during the first few days of the preserving period by a further quantity of the gas until all the oxygen in the eggs has been diffused into the gas, the container being then filled with fresh preserving gas which is practically free from oxygen and so remains. The preserving gas may be passed successively through a number of containers, each container being filled with fresh gas when all the oxygen has diffused from the eggs. Two or three replacements of the gas are sufficient to eliminate the oxygen. Where the preserving gas consists of a mixture of carbon dioxide and nitrogen it can be introduced at the lower part of the container and the air displaced upwardly. The process should be carried out at 0·5° to −0·5° C., and the humidity in the container may be kept at 80 to 90 per cent.

507,524. S.A.C.S.A. Soc. Anon. Conservazione Sterilizzazione Alimentari.

Cooking and preserving foodstuffs; table salt preparations

In cooking meat, vegetables, cereals, and other foodstuffs normally cooked with common salt, a preparation is employed applied directly to the foodstuff or dissolved in its cooking liquor, consisting substantially of common salt and containing 4 to 10 per cent. by weight of sodium or potassium orthophosphate or a mixture thereof, the preparation being in solution alkaline to methyl orange. The cooking processes which may be employed include boiling, steaming, baking, grilling and frying. With meat, improved results are obtained by applying the preparation some time before the cooking. Soluble sulphates and/or bicarbonates may be included—*e.g.*, 1 to 25 per cent. by weight of anhydrous sodium sulphate or 1 to 10 per cent. of sodium bicarbonate. In an example, the preparation contains 7 per cent. by weight of sodium orthophosphate, 5 per cent. of sodium bicarbonate, 10 per cent. of sodium sulphate, and 78 per cent. of common salt. Where chemically pure sodium orthophosphate is used it may be mixed with a small amount—*e.g.*, 0·6 per cent. by weight—of sodium carbonate. The salts used are preferably anhydrous and are non-toxic or employed in non-toxic amounts. Chemical equivalents of the salts may be employed—*e.g.*, sodium orthophosphate may be replaced by the mono- or disodium salt—the preparation being adjusted to the alkaline side by varying the proportion of bicarbonates. The alkalinity of the preparation may be such that 1·4 to 1·6 c.cs. of normal acid are required to neutralise a gram of it, using methyl orange as indicator. The preparation may be used in a concentration of 1 to 1·5 gm. in 100 c.cs. of water. The preparation shortens the time of cooking, makes the food more tender and, in the case of vegetables, preserves the colour.

The specification as open to inspection under Sect. 91 comprises also the treatment of organic materials such as foodstuffs with a preparation containing common salt and a water-soluble salt of one of the trivalent acids of phosphorus, or chemical equivalents thereof, in which may also be included soluble sulphates and/or carbonates and/or bicarbonates. The preparation may also be used as a substitute for table salt. The subject-matter does not appear in the specification as accepted.

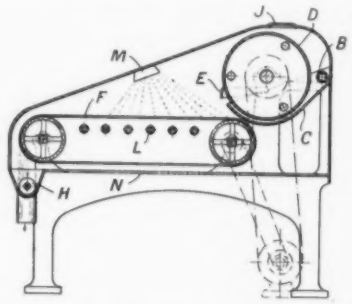
507,904. Chemtex, Ltd.

Preparing and preserving food

Prior to drying on roller driers, fresh vegetables are comminuted and mixed or kneaded into a paste or dough with egg yolk or milk or soya, the dried preparation being comminuted as required. Cereal flours may also be included. In examples, (1) 4,000 parts of fresh spinach are comminuted, mixed with 200 parts of fresh egg yolk, dried on a hot roller and pulverised; (2) 1,000 parts of a fresh, comminuted vegetable are made into a dough with 100 parts of whole milk powder and 400 parts of wheat flour, dried on a hot roller and broken up into flakes.

The specification as open to inspection under Sect. 91 comprises also the use, in place of egg yolk or milk, of preparations made therefrom, and the application of the process to fruit. This subject-matter does not appear in the specification as accepted.

508,751. Rottinger, A. C.



Film evaporators; treating with radiations

A film evaporator comprises a trough C to which the liquid—*e.g.*, milk—is admitted from an inlet B, and a heated roller D provided with a scraper E, which delivers the dried product on to a moving band F, which may be heated by elements L and irradiated by ultra-violet rays from a source M. The finished product is withdrawn by a screw conveyor H from the casing N which encloses the whole apparatus. Steam escapes continuously or intermittently from an exit J.

505,053. Henry, R. S. T.

Complete Specifications Accepted

Printed copies of the full Published Specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, at the uniform price of 1s. each.

509,411. Brodrene Gram Aktieselsbab: Machines for the production of moulded portions or bodies of ice-cream.

509,092. Hobart Manufacturing Co.: Mills for grinding foodstuff, particularly coffee mills.

508,501. Venesta, Ltd., and Barber, H. J.: Insulated containers for cans containing dairy cream and other articles.

511,492. Nicholson, A. O.: Preservation or storage of living vegetable substances, particularly fruit and vegetables.

511,585. Ocean Magyar Konservgyar es Kereskedelmi R. T.: Preparation of vitamin-enriched foodstuffs.

511,394. Jackson, C. J., and Guinness, Son and Co., Ltd., A.: Production of yeast.

511,241. Herbort, A.: Steaming of fruit and vegetables.

511,254. Tennant, W. J. (Crown Cork and Seal Co., Inc.): Method of packaging fruit juices.

511,032. Standard Brands, Inc.: Method for the control of proteolytic activity in the manufacture of baked goods.

510,794. Holton, Ltd., E., and Wall, W. H.: Machines for opening eggs and collecting the contents thereof.